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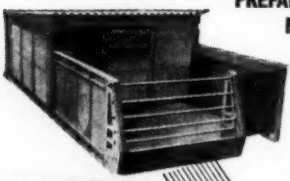

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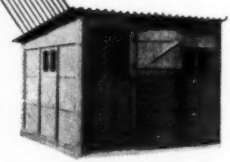

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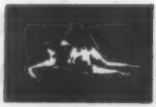

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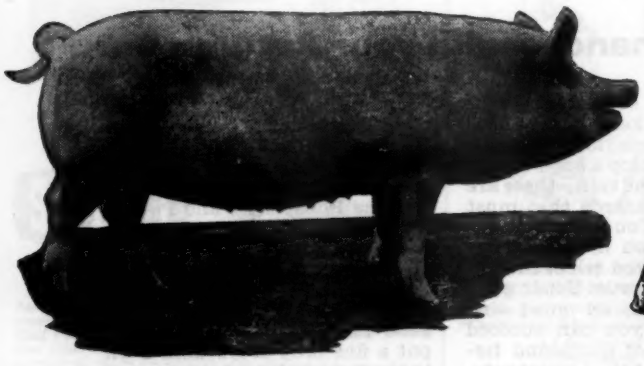

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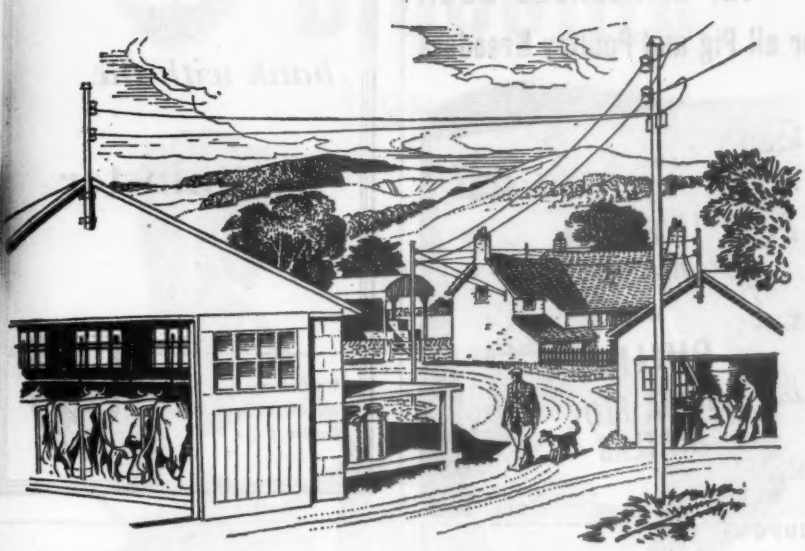

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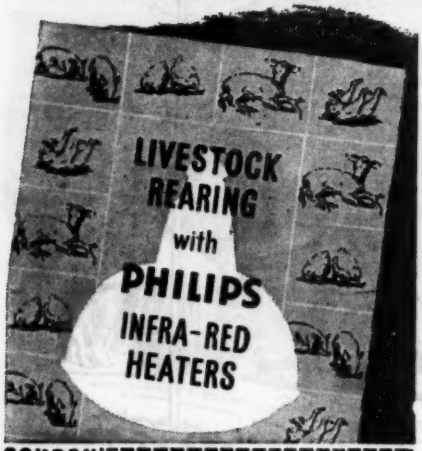

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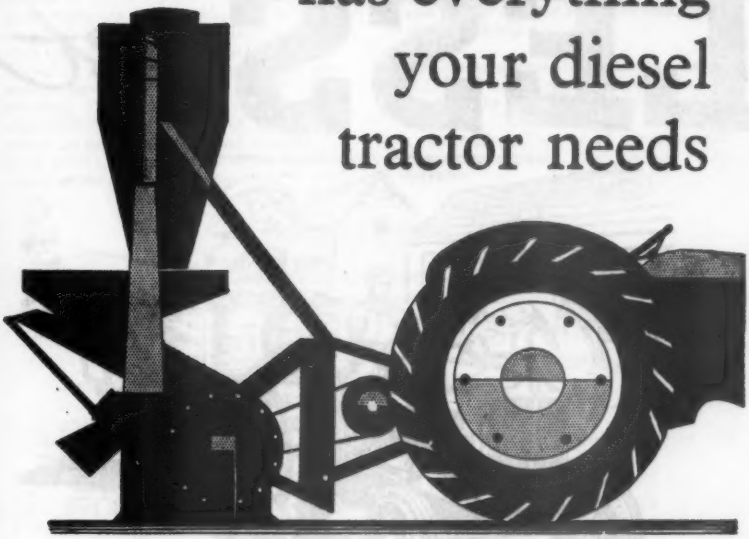

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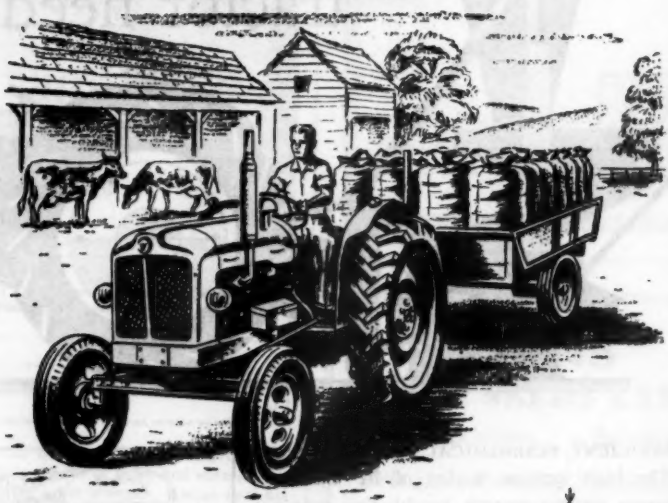

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AGRICULTURE

VOL. LXII No. 6 SEPTEMBER 1955

CALVES REARED AT GRASS

G. H. LAMPKIN, B.Sc., and S. I. J. PARKIN, B.Sc.

Animal Breeding Research Organisation, Cold Norton Farm, Stone, Staffs

In small trials in the West Midlands, dairy calves did better outdoors on grass during their first summer than a similar group fed indoors.

A SURVEY in the West Midlands on the methods of rearing calves in dairy herds indicates that most spring-born calves are not turned out to grass during the year in which they are born. The reasons for keeping them indoors vary, but include fears of worm infestation, the disturbance that may be caused by flies, and the practical difficulties of handling young calves outside. In Holland and New Zealand, however, it is the normal practice to rear dairy calves born in spring and summer out of doors. The calves are kept both loose and tethered in the fields, and milk or other liquid food is fed to them twice daily from a bucket.

To gain experience of outdoor rearing under English conditions, a trial was arranged at Cold Norton Farm, Stone, six calves being reared outside in 1953, and another twelve in 1954. For the purposes of the trial, one-week-old calves were bought from local farmers each year between April and July. Their breeding varied, but they were mainly Friesian, Hereford or Shorthorn crosses. All were two-egg twins. These calves were put out to grass on arrival at Cold Norton and stayed out day and night, regardless of the weather. Whole milk was fed until they were four weeks old, after which a milk substitute was used. This was mixed according to the maker's instructions at 1 lb. of substitute per gallon of reconstituted feed. The calves were weaned at twelve weeks and received an average of 21 gallons of whole milk and 44 gallons of the substitute. Concentrates were fed throughout the experiment on a scale determined by size, rising to 2¾ lb. a day for calves weighing over 266 lb.

Tethering was attempted during the early stages of the trial in 1953. The calves were on about ten feet of rope and were moved daily to positions in the shelter of a hedge, but, because of heavy rain in May and June, the animals became very dirty and tethering had to be abandoned. They were therefore turned loose and allowed to find shelter and a clean position for themselves. When free, the calves moved frequently and found the maximum of cover, and even in heavy rain were able to keep clean by lying in hedge backs or in long grass.

Tethering was not tried in 1954, the calves being loose all the time. Their 2-acre paddock was split up by sheep netting or electric fencing to permit of

controlled grazing, but the calves were always allowed to run back over areas they had grazed previously. From the end of April to mid-September twelve calves were kept on 2 acres of permanent pasture which had not been grazed earlier that year. Afterwards they were given another 2¼ acres of aftermath, on which they remained until the experiment ended in late October. This second field had been cut for silage in mid-June and grazed lightly by older cattle in July and August.

When first put out the calves started to nibble at the grass, and by the end of each year's trial they were able to graze their paddocks really clean. The calves were caught and tied for feeding, but this was necessary only because the experiment required each calf to be rationed individually. There was no difficulty about this before weaning, but later the calves were sometimes reluctant to be caught, since they then received only concentrates. Under commercial conditions, however, it would not be necessary to catch them very often and, provided the paddocks are near the buildings, there are no practical difficulties in feeding either milk or milk substitute.

Outdoor Calves Healthy and Heavier Weekly weighings showed the calves to be thriving steadily in both years. They grew, on average, 3 lb. per week faster than a similar group of calves reared inside. The latter had the same rations of milk, milk substitute and corn, but received silage and hay *ad lib.* instead of grass. In the course of the two years twins of eight of the inside calves were included in the outside group.

Average Weekly Rate of Growth (lb. per week)

	Outside Group			Inside Group		
	Before Weaning	After Weaning	Whole Experiment	Before Weaning	After Weaning	Whole Experiment
1953						
Six sets of twins split between inside and outside rearing	8.5	11.7	10.0	6.6	9.3	7.7
1954						
Two sets of twins split between inside and outside rearing	9.6	13.1	11.5	7.4	7.1	7.2
10 other calves on each treatment	9.3	11.1	10.1	6.6	6.3	6.5
ALL CALVES	9.0	11.4	10.2	6.8	7.6	7.2

These results show that under the conditions at Cold Norton calves can be reared outside successfully, and this is considered the main finding from these experiments. The differences in growth rate between the inside and outside calves may be a little exaggerated, at least in regard to the 1954 results, because the hay available that year was deficient in quality, so that the inside calves did not do as well as was expected.

An average growth rate of 10.2 lb. per week for the outside calves indicates that their health was generally good. Some slight cases of nutritional scour occurred in both the inside and outside groups, but in no instance was it serious enough to cause real concern. All cases were quickly cured.

Trouble from internal parasites was anticipated at the start of the experiments, and faeces samples were therefore taken twice in each year to check on the levels of infestation. In 1953 some scour, suggestive of worms, was noticed in the outside group towards the end of August, and the samples for worm counts were therefore taken on August 25 and October 17. Little evidence of infestation was found, however, and the worm burdens in the October samples were found to be very low indeed. The tendency for the outside calves to scour disappeared by mid-September, and did not recur.

The 1954 samples were taken on July 2 and October 19. In the July samples coccidia were the only organisms found, and these occurred only in two calves, both of which were reared inside. The October samples, however, showed five of the outside group to be infected with Trichostrongyles. One of the five calves also had stomach worms, and another had nematodes. The worm counts ranged from 50 to 500 Trichostrongyle eggs per gramme of faeces, which is higher than usual although still low from a clinical aspect. It might be expected that if outside rearing were tried on some other farms, heavier infestations might result. No evidence was found of husk, but this trouble is not common at Cold Norton.

Flies were not a serious problem, and were only a nuisance immediately after dehorning. However, the weather was never really hot in either summer and flies were perhaps not as numerous as usual.

A Practical Proposition Since these studies were started, reports have been made of similar trials at the National Institute for Research in Dairying (1) and at King's College, Newcastle-on-Tyne (2). The N.I.R.D. results were similar to our own, but at Newcastle, where the weather was very bad and no concentrates were fed, the calves did not thrive as well as those inside. Parasitic worms were partly the cause of the unthriftiness. Nevertheless, the experience gained from these trials of outdoor rearings suggests that the method is practicable in some parts of England and that good calves can be reared outside at grass.

There must often be occasions when it would be convenient to carry out small-scale trials of this nature and, on the results so far obtained, further experience under a wider variety of conditions might be well worth while seeking.

Thanks are due to the Ministry's Veterinary Investigation Centre at Wolverhampton for making the worm egg counts of the faeces of the calves in both years, and to Mr. J. S. Tavernor, manager at Cold Norton, for his interest and encouragement.

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1. J. M. B. Roy and K. W. G. Shillam. *Farmer and Stock-Breeder*, Feb. 1954, p. 71.
2. T. R. Preston. *J. King's College Agric. Soc.*, **9**, 24-8.

Gilbert White Museum

The village of Selborne in north-east Hampshire can justifiably lay claims to being one of the prettiest and most famous of English villages. That it is so well known is due in no small degree to the eighteenth-century writings of one of its greatest sons, the Reverend Gilbert White, often referred to as the Father of English Natural History. It is fitting, therefore, that The Wakes, Selborne, the old house in which he spent nearly all his life, should have been purchased for the nation and endowed as a perpetual memorial and museum to Gilbert White.

The Wakes, which also now contains the Oakes Memorial Library and Museum, is open to the public every day, except Monday, between 3 and 6 p.m. at a charge of 1*s.* 6*d.*

PRODUCTION AND PROFIT ON A SMALL DEVON FARM

V. H. BEYNON, B.Sc.

Department of Economics, University of Bristol

and

T. H. DAVIES, B.Sc.

National Agricultural Advisory Service, South-Western Sub-Centre

What are the possibilities of increasing profit on the small farm? This account shows how a Devon farmer has increased his farm income nearly threefold in the past three years by intensive production and good management.

BECAUSE of the low profits quite often associated with a small business, farmers with small acreages of land may find it difficult to get a reasonable standard of living for themselves and their families. This does not mean that large profits cannot be earned in a small business, but merely that the chances of large profits are greater in a big enterprise. For an example of what can be done on a small farm, however, let us look at Mr. P. Hansford's farm at Ottery St. Mary in Devon.

Mr. Hansford became a tenant farmer on Pitfield Farm, a holding of some 53 effective acres, in 1950. The land extends for nearly a mile along the Ottery St. Mary–Exeter road, the buildings being clustered at one end of the farm. The fields are reasonably flat, have a southerly aspect, and are fairly well supplied with water. The soil is not very fertile; most of the fields, derived from the "Pebble bed" formation, are light, free-draining loam. The soil on the other fields is derived from the Lower Marl formation and is medium to heavy. By borrowing most of the capital needed, Mr. Hansford was able to acquire the livestock, crops, machinery and equipment belonging to the previous tenant. The average annual results for the first two years are given in Table 1.

Table 1

Farm Trading and Profit and Loss Account
(average of 1950 and 1951)

Costs	£	*Output*	£
Labour	637	Cattle	125
Feeds	764	Milk	1,933
Seeds	119	Pigs	84
Manures	238	Poultry	251
Rent	150	Crops	121
Power and transport	294		
Contract	23		
Sundries	272		
	2,497		
Management and investment income	17		
Total	2,514	**Total**	2,514

The annual output of £2,514, which is equivalent to £47 per acre, was quite satisfactory, but the costs, including an allowance for the work done by the farmer himself, amounted to £2,497. The difference, shown in the table

as management and investment income, was a mere £17—equivalent to 6*s.* per acre. Since most of the capital was borrowed, it was obvious that the income was totally inadequate to meet the annual commitments, such as interest charges and repayment of the loan. Changes had therefore to be introduced without delay—the first of them, a more intensive system of farming.

Milk production, the main enterprise on the farm, fitted in with the farmer's personal preference, so that the immediate problem became one of increasing the output of milk. The quickest way of doing this would have been to buy high-yielding cows, but this was out of the question because of his lack of capital. The alternative was to rear heifers capable of giving high yields, and this was done with considerable success. In addition, despite rigorous culling of the low yielders (the turnover in cows in 1952 was 53 per cent), the size of the milking herd was steadily increased. The effect of this policy is clearly shown in Table 2.

Table 2

Size of Business

	1950-51	*1952*	*1953*	*1954*
Capital invested (£)	2,671	3,028	3,165	3,177
Average number of cows	18.2	18.0	21.0	23.5
Turnover in cows (*per cent*)	33	53	21	17
Ratio of cows to other cattle	1:0.9	1:1.0	1:0.7	1:0.7
Average annual yield per cow (*gal.*) ...	685	790	760	818
Milk sold (*gal.*)	11,459	13,271	14,703	18,542
Output of milk (£)	1,933	2,391	2,680	3,316
No. of poultry	150	130	230	255
Output of poultry enterprise (£) ...	251	423	761	892
Cost of feedingstuffs (£)	764	937	1,158	1,533

Besides increased stocking, followers had been reduced by 1954 to a very small proportion of the herd. Mr. Hansford believes that eventually he will be able to maintain his herd at full strength with five followers for every ten cows. (The present ratio is 7:10, but a bigger herd is being built up.) This would mean that two heifers calving at 2½ years old would enter the herd every year, and that each cow would remain in the herd for an average of five years. This aim has already been achieved over the past two years. The benefits are obvious, since most of the cows are given an opportunity of reaching peak performance in their third and later lactations, and, as a result, the Guernsey herd now averages well over 800 gallons.

To supplement the farm output still further, the poultry enterprise has been expanded; in 1954 it accounted for 20 per cent of the total farm output.

Production based on Grass Greater numbers of more productive cows and poultry demand more feed, and in this case part of the extra food requirements was purchased. Buying in food is one way in which the small farm can overcome the handicap of a restricted acreage, but it can be an expensive means of increasing output. In Mr. Hansford's case it has been used in addition to making every effort to grow maximum quantities of stockfood from the land itself. Here the climate and size of the holding indicated that the greatest contribution to total feed requirement could best be made by good crops of grass and kale. Stockfeed requirements do not fluctuate very much from year to year, so approximately the same acreages of feeding crops should be grown each year, bearing in mind (a) the needs of the livestock, (b) the desirability of maintaining both the crops and livestock in a healthy, virile condition, and (c) the possibilities of raising the fertility level of all the fields on the farm. Rota-

tions to meet all these requirements were introduced in 1952 and have since been strictly adhered to.

By dividing one large field and bringing together the more accessible parts of two small fields, Pitfield Farm was readily split into eight 4-5 acre blocks. Such a unit was considered sufficient to provide kale for grazing by the stock being carried at that time, so that only one block of kale a year was thought to be necessary. Because of the elongated layout of the holding, the arable land was farmed in two rotations. Rotation A, which contains the kale, was confined to the fields nearest to the homestead. The two rotations selected were: (A) kale, followed by a three-year ley; and (B) a four-year ley. In both cases the leys are sown direct, and grazed as maiden seeds. On certain convenient fields in Rotation B the ley in its last year is ploughed early, sown to a catch crop of 20 lb. per acre Italian ryegrass in August or September, grazed early in the following spring and then reseeded. Such a practice has much to commend it, particularly in a high rainfall district, for it provides early keep at a time when the ground has not dried out sufficiently to permit grazing without risk of severe damage to established leys by poaching. It can therefore shorten the winter feeding period and save expensive concentrates.

Keeping strictly to fixed rotations of this kind does confer several advantages. Regular renewal of the leys keeps them in a young, productive condition so that they respond well to generous manurial treatment. They build up soil fertility and enable excellent crops of kale to be grown when the turf is ploughed in. In addition, two fields of early-sown maiden seeds are available every year to provide leafy grazing through the midsummer period, when the older leys are not giving such good quality herbage, and to yield occasional cuts of spring-quality autumn silage. Each year, the field in Rotation A which is due for ploughing is used as a "sacrifice field", and in consequence it may be, and usually is, badly poached. But it does save the other leys from the danger of winter treading. The rotation is so arranged that this field adjoins the kale and can be used as a lie-back when this crop is being folded. The treading of the cows while grazing the kale has proved to be an excellent preparation for the grass seedbed that follows. Further ploughing is not usually necessary, since a good tilth can be obtained by disc harrowing and rolling. Finally, Mr. Hansford is fully aware of his future commitments and he can plan ahead with confidence.

High Standard of Management Since grassland occupies such a prominent and important part in Mr. Hansford's farming, his management must be of a high order. It is based, in the first instance, on generous manuring. Each year every acre of grass receives a basic dressing of 3 cwt. 18 per cent superphosphate and 1 cwt. 50 per cent muriate of potash per acre. This is applied in March in the form of a phosphate-potash compound fertilizer. In addition, dressings of nitrogenous fertilizer are given to provide an early bite, heavy silage cuts, or out-of-season grazing.

Only the vigorous, leafy, bred strains are included in the seeds mixtures, which are carefully prepared to provide maximum production over as long a grazing season as possible. Although several types of mixtures have been tried, it would appear that for a small, intensively-managed dairy farm such as Pitfield, two are adequate. One mixture is based on New Zealand short-rotation ryegrass or S.22 Italian ryegrass; the other is of the timothy/meadow fescue type. However, this year Mr. Hansford is experimenting with a timothy/late-flowering red clover mixture on the field farthest from the buildings. This, he hopes, will give an exceptionally heavy crop of grass for

ensiling, and the quality of the herbage should remain high until quite late because of the late-flowering habit of the timothy.

All the grass is carefully utilized. The leys are always strip-grazed, but so far it has not been found possible to use a back fence, mainly because of the siting of water troughs. But, since the fields are comparatively small and the number of stock large, this is not a serious disadvantage. Practically all the grass surplus to grazing requirements is ensiled in a 100-120 ton pit, which is sited near the buildings for ease of winter feeding. The shape of the farm makes a green crop loader essential for silage-making. Only about 4 acres are made into hay every year.

The effect of better grassland management is clearly brought out in Table 3. Whereas the "feed acres" used per animal have continued to decrease because of higher productivity, the starch utilized has increased from 13.7 cwt. per acre in 1950-51 to 17.2 cwt. in 1954—a difference equivalent, in terms of starch, to over 5 cwt. of dairy cake. The milk produced from the land itself and the number of cows maintained have risen steadily, so providing further evidence of the improvements which have taken place at Pitfield. In calculating the milk produced from purchased concentrates, 5 lb. of food has been allowed for each gallon of milk, because of the yield levels and the fact that Channel Island milk has a high butterfat content.

Table 3

Production from Grassland

	1950-51	*1952*	*1953*	*1954*
Manures applied (£)	238	258	282	289
Seeds (£)	119	27	31	38
Total feed acres per animal unit ...	2.15	1.92	1.90	1.83
Total milk production (*gal.*)	12,471	14,228	15,960	19,224
Milk from purchased food (5 lb. per gallon)	*	8,064	6,944	11,648
Milk produced from farm	*	6,164	9,016	7,576
No. of cows maintained	18.2	18.0	21.0	23.5
S.E. utilized per acre (*cwt.*)	13.7	14.4	15.6	17.2

* not available

Rising Tide of Profit Mr. Hansford still feels that there is ample scope for further improvement. So far, it has not been possible to bring 15 acres of poorly drained, permanent pasture into a rotation, but drainage work has been started, and over the next few years this area will be brought into line with the rest of the farm. The effect on production will be considerable. Even with the present leys, there is scope for development. Firstly, the dressings of nitrogenous fertilizer could be increased with advantage on the short leys (this year several fields will have received two dressings of 2 cwt. each per acre); secondly, even more efficient utilization of the grazed grass could probably be achieved by using a back fence for the folded stock.

Table 4

Financial Results per Acre

	Average 1950 and 1951	*1952*	*1953*	*1954*
	£	£	£	£
Output	47.0	59.4	66.6	84.4
Costs	46.7	51.6	59.8	76.1
Management and investment income ...	0.3	7.8	6.8	8.3
Net farm income	5.1	13.2	12.4	14.1

The financial results of the farming operations, given in Table 4, reflect the various changes introduced during the period. Mr. Hansford's success in overcoming the difficulties of organizing and managing a small farm stems from more than one root, but his methods have been of the type which can be used by most small farmers. Briefly they were: carrying more cows; obtaining higher milk yields; keeping replacements to a minimum; increasing the size of the supplementary poultry enterprise; introducing good rotations; and applying generous quantities of manures. But what is particularly gratifying in this case is the increased contribution that the grassland is making to vital feed requirements.

GRASSLAND DAIRY FARMING IN THE INDUSTRIAL PENNINES

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By good grassland management and generous fertilizing and liming, farmers on the intensively stocked upland dairy farms of the industrial West Riding are finding it possible not only to keep up a high output of milk for half the year almost entirely from grass, but also to provide silage and hay for winter keep.

THE most drastic upheavals in farming methods during the Second World War occurred in the heavily stocked grassland districts, where so much reliance had hitherto been placed on purchased foods. The Industrial Pennines qualified for that description and, in addition, had special obstacles to successful cultivation. Nevertheless, a partial self-sufficiency was achieved in spite of steep slopes, matted turf, soil acidity, and smoke pollution, for the rainfall of around 40 inches a year and a tolerable depth of soil provided the essentials for productive grassland after liming, fertilizing and reseeding had established a sward.

After the war, a number of farmers were progressing beyond casual reseeding and aiming at a complete system of grassland farming, although there was uncertainty as to how far lowland techniques of herd and grass management would succeed. Thus was created an opportunity for advisory and investigational work, which was, to some extent, met by beginning a simple system of grass recording in the Huddersfield area of the West Riding of Yorkshire, where, before the war, the typical system of flying herds fed on purchased concentrates had been followed.

For the purposes of this investigation the grazing season was assumed to cover the period when the cows were getting more than maintenance from grass. Each day during this time a record was taken of where the stock grazed, their numbers, the total milk production and the weight of concentrates fed. The resulting figures were expressed as "cow-days" and "gallons of milk from grass". Cow-days (number of cows × number of days) per field or per acre are a straightforward calculation, even when making adjustments for heifers. Output of milk per acre is equally easy to calculate if no concentrates are fed; where extra feeding is given, as it is in most cases, a gallon of milk is deducted for every 4 lb. of concentrates fed. Thus if 40 lb. is fed on a day when 60 gallons of milk are produced, the net output from grass can be estimated at 50 gallons. It is, of course, a conven-

tional estimation, since a cow does not yield a gallon more for every 4 lb. of cake eaten or a gallon less if the cake is taken away, but it is a simple system and it provides a guide to the productivity of individual fields with a not inflated figure of net gallons per acre.

The reason for confining recording to the summer was primarily to draw attention to the locally neglected fact that grass growing in the field could be the dairy cow's cheapest and best food. Since grass mixtures, fertilizing and approximate weights of silage and hay were also noted, a fair assessment of each farm's policy and achievements could be made.

Three Farms Compared Of the five farms co-operating in the survey, three have been chosen for description here. For simplicity they are referred to subsequently as Farms A, B and C. They are situated in a typical section of the Pennines where the valleys are likely to be industrialised and the hill tops scenically spectacular (see p. iii of the art inset). The dairy farming takes place in between.

Farm A. Out of a total of 60 acres, 50 are fully productive and are divided into 27 walled fields. Soil is of medium textured Millstone Grit and, although at a height of 900 feet, the farm is on a gentle slope. Since 1948 it has been intensively managed for high grass yields. The acreage is mainly divided between short-rotation ryegrass/white clover leys and the longer leys of timothy/meadow fescue/white clover, with some older Cockle Park type swards. Grass is the only crop and is heavily fertilized; over the last two years every acre has received an average of 4½ cwt. complete compound fertilizer and 3½ cwt. "Nitro-Chalk" each year. The cattle are good, attested Ayrshires and Friesians. A.I. has been used for three years and a few calves are reared, but they are mostly summered away on other land. All the milk went as "T.T. Farm Bottled" at one time, but a large proportion is now separated for cream. To some extent production has been levelled out throughout the year, but calvings are still concentrated in the autumn.

Farm B is an all-grass farm of 23½ acres at 800 feet, with an awkward slope at one end and a drainage problem at the other. After six years of intensive management, a quarter of the acreage is in short-rotation leys and the remainder in Cockle Park types. Fertilizing has usually been in the region of 3 cwt. superphosphate and 2 cwt. "Nitro-Chalk" per acre. The attested herd is a mixture of Shorthorn and Friesian, and although A.I. is used "breed to breed", it is intended to concentrate on the Friesians. The heifers are reared and have very largely been kept at home, which has involved heavy summer stocking. The milk is sold wholesale, so there is a strong emphasis on winter milk.

Farm C lies along an industrial valley and is split up by a large poultry unit, a small mill, a builder's yard, a football field, a river and a canal. Most of the 42 acres that remain for farming consist of deep, easy-working alluvial loam maintained in a fertile condition by annual dressings of poultry manure. No inorganic fertilizers have been used. More than half the acreage is in permanent pasture yielding heavy crops of hay; reseeding is proceeding at the rate of a field a year following a rootbreak. Except for turnips and cabbage, no arable crops are grown. In 1950 a pedigree attested herd of Jerseys was established, and it is proposed to build up to 60 cows and followers, which will make haymaking impossible. The milk is sold as "T.T. Farm Bottled" and production is fairly even throughout the year.

On all three farms, regular liming is essential and dressings of 2-3 tons per acre of ground limestone are usually given to the fields ploughed for reseeding. Grazing is controlled by electric fences on Farms A and B, and

not on Farm C. An important common factor in these varied situations is a high standard of stockmanship.

Analysing Output It will be seen from the "Weeks Grazing" column in Table 1 below that Farms A and B muster 24 weeks productive grazing in a favourable year, while Farm C reached 31 weeks in 1953 without using fertilizers and on old pasture. This is an instance of the effect of altitude and exposed situations on growth. Farm C, which is in a narrow valley and about 350 feet lower than the other two, can expect to start grazing about a month or six weeks earlier than the upland farms and continue for two weeks longer in the autumn. Early fertilizing has been tried many times on the hills but it is only in exceptionally mild springs that there is a real response before the end of April. Italian ryegrass, or its hybrid varieties, is not noticeably earlier than the other leys, but lives up to its reputation better for late production in autumn. On old upland swards growth is delayed even longer, but the extension of the grazing season through leys is clearly only slight compared with what is achieved by similar methods elsewhere.

Table 1

Output of Selected Farms during Grazing Seasons, 1952 and 1953

Farm	No. of Cows	Effective Acreage	Weeks Grazing	Cow-days per acre	Net Milk per acre	Total Milk	Silage	Hay
					gal.	*gal.*	*tons*	*tons*
				1952				
A	22	50	23	85	128	9,653	145	35
B	12	20	24	102	107	3,632	27	11¼
C	19	42	28	97	101	6,507	—	25
				1953				
A	22	50	24	78	131	12,025	180	18
B	13	20	20	86	70	3,255	25	9
C	26	42	31	152	150	10,942	—	22

Note: The figures in the columns headed "Effective Acreage" and "Weeks Grazing" have been used to determine the data in the subsequent columns in the table.

The table also shows that Farm B had a less successful summer in 1953. The usual second dressing of nitrogenous fertilizer given in June was first postponed and then omitted following a breakdown of the fertilizer distributor. It was hoped to clear one or two hay fields quickly and provide aftermath grazing, but the weather broke and prevented progress. By August, keep was really short and concentrate feeding had to be increased, until by September it was estimated that the cows were getting maintenance only from grass. Thus the recorded grazing season came to an end after 20 weeks. The figures of 86 cow-days and 70 gallons per acre apparently represent a fall in the stock carried: in fact, there were, if anything, too many. Thirteen cows, 4 bulling heifers and 4 yearling heifers on 23 acres is near the limit for a difficult farm. Fortunately, the silage made in 1953 was of excellent quality and atoned for some of the milk lost in the summer. The incident not only bears out the need for late dressings of nitrogen, but illustrates how much depends on everything going right on a small farm.

As the cows on Farm C are Jerseys, the high cow-day figures for that holding have not the same value in comparison with the other farms.

Grass Conservation versus Grazing Except for the special case on Farm C mentioned later, the grassland will be expected to make a contribution to winter milk production, and the hay and

silage will be taken from the fields that also have to provide grazing. Farms A and B follow the now quite common routine of cutting their H.1 short-rotation ryegrass for silage in May. It makes such excellent silage that there is no chance of its escaping at that time of the year, although the second growth is frequently inclined to flower instead of producing leaf. On the other hand, spring- and summer-sown Italian ryegrass is ready for its first grazing at what is often a difficult period, and gets careful management as a result. A 2-acre field on Farm A was sown with 40 lb. per acre of commercial Italian ryegrass in May 1953; it produced 522 gallons of milk per acre (net) up to the end of September.

Silage is not entirely a competitor with the cow, as cuts can be taken and cleared in May from fields which, if left for hay, would be out of commission until August, as far as the herd was concerned. Haymaking definitely sets a low limit to the number of stock that a small farm can carry, and when there is a case for building up the herd less hay must be made or, as may happen to Farm C, the farm must be grazed and all winter fodder bought. But this would be an exceptional solution.

It may be useful to refer again to Table 1 to note the amounts of hay and silage conserved by these farms while the herds were simultaneously building up creditable milk production figures.

Winter or Summer Milk? Two patterns of output are represented in Table 2. The farmer on Farm B, the small wholesaler who needs to sell as much winter milk as possible, enters the grazing season with his cows past their best, but yields are sustained by the May grazing. In June and July most of the herd is dry or nearly so, but the calvings of August and September begin to restore production to winter level. Farm C, with a contract for "Farm-bottled Jersey Milk", has the retailer's interest in fairly steady production throughout the year.

Table 2

Monthly Milk Output from Selected Farms, 1952 (gallons)

	Farm A		Farm B		Farm C	
	Total	From Grass	Total	From Grass	Total	From Grass
May	2,174	1,867	725	507	1,217	907
June	1,750	1,526	492	372	1,065	765
July	1,467	1,161	363	301	1,090	780
August ...	1,484	878	748	456	1,004	662
September ...	1,835	627	824	346	905	594

The highest yields per acre could not be expected from Farm B in view of the relative unimportance of summer milk, but low concentrate feeding restores the balance to some extent. It is not often that it is completely stopped, as generally there are one or two cows that have calved late, are milking well, and are considered worth helping with some cake. Heavy milkers vary in their ability to milk off grass, so there is a justifiable reluctance to experiment.

The general trend of concentrate feeding in summer can be followed from the management at Farm A.

Table 3

Farm A—Average Weekly Weights of Concentrates Fed during Grazing Seasons 1952 and 1953 (cwt.)

Year	Cows in Milk	May	June	July	August	September
1952	22	2¼	2	2½	5	10
1953	22	3	3¼	6	9½	12¾

Cows and heifers calving from July onwards will be the mainstays of winter milk output, and unless they are given a ration before calving and supplementary feeding afterwards, yields will fall around Christmas. Therefore there is always the late summer rise in feeding, which here appears in August in 1952 and, due to earlier calvings, in July the following year. The amounts fed in 1953 were also affected by the lifting of restrictions on the sale of cream from April; Farm A was able to find a good outlet and milk yields had to be kept up to satisfy demands. More concentrates were therefore used to that end.

How effective this was is uncertain, since the quality of the grazing has the quickest and greatest influence on yield, especially in early summer, and it is useless to try and make up deficiencies by extra feeding, although it may be possible to delay drops in the yield of particular cows until new calvings come to the rescue. This is economically justifiable when a relatively high price is being obtained for summer milk.

Output per acre from grazed grass should therefore be considered in relation to the method of selling the milk that a farm adopts.

A.I. and the Small Farm Calf rearing does not mix well with a small acreage and a dairy herd. Instead of all the grass bringing in a cash return through milk, part will be eaten by growing stock that contribute nothing to income. Yet more calves are being reared on small farms. The increasing number of farmers with attested herds find their replacements extremely expensive to buy and are also attracted by the quality of the calves got by artificial insemination. For the first time farmers have the pleasure of owning heifers that are not just a "breed type" of roughly the right colour and shape, but instead exhibit the qualities of style, character and refinement found in the better pedigree herds. A smart calf is not necessarily a good milker, but the obvious prepotency for conformation that the A.I. Centre bulls display raises hopes that they are also capable of passing on their ancestral milk.

Exactly how much rearing the 20-30 acre man can manage is a matter for individual decision, strongly influenced by breed preferences. A.I. is the only means whereby the enthusiast can transfer by degrees to the breed of his choice without crossing the rest of the herd or buying in more than a nucleus of expensive cows.

Intensive Farming at Low Cost The "forage farming" expert may feel that a wholehearted grassland policy has not been achieved in the cases that have been discussed. It is quite true that there are others who can prove a greater reliance on grass and at the same time show a satisfactory rise in gross production. A high total milk output is essential if the small dairy farmer is to make a living and most of them would consider that well-timed supplementary feeding is an easier and quicker means of getting a rising annual turnover. It would not be difficult to get the worst of both worlds in spending heavily on concentrates after growing good grass at considerable cost, but there is no evidence that any of the farmers discussed here fell into this trap.

Intensive grassland farming is never likely to be easy in these upland areas, but it has brought dairying through difficult times and is likely to remain in the immediate future. The creation of these highly efficient holdings and the others like them from virtually unproductive land must be one of the major achievements of farming in this country.

FOLIAR APPLICATION OF NITROGEN TO WINTER WHEAT

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Preliminary results of trials in Hertfordshire suggest that there are no advantages, either in terms of dry weight or crude protein, to be gained by applying nitrogen to winter wheat as a urea spray, instead of as a solid top dressing.

DURING the past few years considerable interest has been shown in this and other countries in the application of nutrient substances as sprays to growing crops. Some market gardeners have added small amounts of nitrogen compounds to the water used in overhead irrigation and have claimed excellent results for the practice, which is now many years old. Scientific workers have used dilute solutions painted on leaf surfaces to detect nutrient deficiencies and have applied the deficient substances as sprays to the foliage of the crops. Usually, as in the case of manganese, the amount of the substance needed per acre is only a few pounds, but in some cases (for example, magnesium applied as Epsom salts in glasshouses) the quantity required is considerable. Comparatively recently the aeroplane has been brought into service to apply solutions of fertilizers to grass and other crops. From all this work the grower is, of course, led to ask the question: "Can the same weight of fertilizer produce a bigger effect when applied as a spray to the growing crop than when applied dry in the usual ways?" Only carefully conducted experiments on a number of crops over several seasons and a variety of conditions can give a satisfactory answer to this question.

Recently, Low and Armitage have reported in this JOURNAL* the results of two thorough experiments carried out at Jealott's Hill on the application of urea to grassland. They showed very clearly that, in this case, there was no advantage whatever in dry matter or protein production by applying the urea in solution, as compared with broadcasting the urea in the form of fine crystals.

In Hertfordshire, preliminary tests with strong solutions of urea on winter wheat around flowering-time were carried out in 1951 and 1952 but, with the other work on cereals in progress then, it was not possible to start systematic experiments until 1953. Two years' work is now completed and, although it was intended not to publish any results until after four harvests—as with the other cereal trials conducted in the county from 1942 onwards—the figures already obtained support so strongly the conclusion of Low and Armitage that it seems worth while to place them on record in summary form at this half-way stage.

Six Treatments Six experiments on commercial farms (three each in 1953 and 1954) were started and carried through to completion. In each trial four high-yielding varieties—Bersée, Cappelle, Hybrid 46 and N.59—were sown, each variety forming a block which was subdivided into six side-by-side plots. At some centres fertilizer treatments of other varieties were tried out, but in the summary given here only the four common to each centre have been included.

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* Foliar Application of Nitrogen on Grassland. A. J. LOW and E. R. ARMITAGE. November 1954, pp. 368-73.

FOLIAR APPLICATION OF NITROGEN TO WINTER WHEAT

In two of the six experiments, both in 1954, there was the very unusual result of no response to the nitrogen top dressings. Since the present purpose is to compare "Nitro-Chalk" and urea as well as the two methods of applying urea, only the four experiments where a marked response to nitrogen was obtained have been used to compile the tables. The exceptional cases will be considered when the four years' work has been completed, and they should, of course, be taken into account when calculating average responses to nitrogen. The six treatments were:

	Late April	Late June
1.	nil	nil
2.	"Nitro-Chalk"	nil
3.	Urea, dry	nil
4.	Urea, spray	nil
5.	Urea, dry	Urea, spray
6.	"Nitro-Chalk"	"Nitro-Chalk"

All the dressings were equivalent to 2 cwt. "Nitro-Chalk" per acre (that is, they supplied 0.31 cwt. N.). The symmetry of the treatments would have been improved by a seventh treatment—namely, urea as a spray in both April and June—but it would have complicated the field work and was omitted intentionally. The plot size was about one-fortieth of an acre and the strength of the spray about 15-20 per cent, sufficient liquid being used in the knapsack sprayer to enable a plot to be traversed twice.

Effects on Yield and Protein With four varieties under test in each of four experiments, there was, in all, 16-fold replication of the treatments. In the tables the results for individual centres are not given, but only the means for the sixteen replicates. As will be seen from Table 1, the "Nitro-Chalk" was clearly more effective than urea when applied in April, but slightly less so in June. There was no advantage from applying the urea as a spray in April.

Table 1

Effect of Treatments on Yield of Grain (cwt. per acre)

Average Yield of Nil Plots		Extra Yield "Nitro-Chalk"	Urea (dry)	Urea (spray)
29.6	April ...	7.0	5.6	4.9
	June ...	1.4	1.65 (spray)	—

Table 2

Effect of Treatments on Percentage Protein in Grain

(D.M. in grain 86.5 per cent. N in wheat protein 17.54 per cent)

Average Protein Percentage of Nil Plots		Increased Protein Percentage "Nitro-Chalk"	Urea (dry)	Urea (spray)
8.73	April ...	0.18	0.22	0.16
	June ...	1.30	1.14 (spray)	—

In April, as is usual when substantial increases in yield are obtained, the rise in protein percentage is small. The slightly higher rise for dry urea almost exactly compensates for the lower yield increase as compared with "Nitro-Chalk". The sprayed urea appears distinctly less effective than the dry.

In June, when, as would be expected, yield effects are small, the protein percentages are considerably increased. "Nitro-Chalk" gives a slightly higher increase than sprayed urea, but this is accounted for by a slightly lower yield increase.

FOLIAR APPLICATION OF NITROGEN TO WINTER WHEAT

Table 3

Effect of Treatments on Yield of Protein (cwt. per acre)

Average Protein of Nil Plots		Extra Protein		
		" Nitro-Chalk "	Urea (dry)	Urea (spray)
2.60	April ...	0.68	0.57	0.475
	June ...	0.56	0.56 (spray)	—

In April, " Nitro-Chalk " again appears superior to dry urea, and this, in turn, to urea as a spray. The percentage recoveries of the applied nitrogen can be calculated from the above figures and are, respectively, 38, 32 and 27. In June, " Nitro-Chalk " and sprayed urea produce exactly the same amount of protein, with a recovery of 32 per cent.

The results suggest that in April, when much of the urea spray must fall on the ground, there is a danger of an appreciably greater loss than when applied dry. In June, when the height of the crop would presumably prevent much solution from reaching the ground, sprayed urea equals, but does not surpass, the efficiency of " Nitro-Chalk ".

It will be interesting to see if, in seasons when the months of May, June, July and August are less humid than in 1954, urea as a spray can be more effective than " Nitro-Chalk ". So far, however, these experiments with winter wheat support the conclusion reached by Low and Armitage with grass that " there are no advantages in terms of dry weight or crude protein to be obtained by applying urea in solution as a foliar spray instead of in the form of the conventional solid top dressing: similar yields are obtained by both methods ".

INDOOR STORAGE OF POTATOES

On balance, there is a lot to be said in favour of storing potatoes indoors instead of in a clamp. The chief advantage, of course, lies in the fact that you can be independent of the weather and the men can get on with the job of grading and bagging under cover. Another thing—you don't have to keep moving the riddle from one place to another. Neither is time taken up opening the clamp—and making it good again afterwards. If you have lighting in the shed, grading and bagging can go on if necessary long after the time when it would be impossible outside. Under these conditions the crop can be bagged up to the limit of the frost-free storage space you have at your disposal, and so get ahead of delivery requirements. Another point in favour of indoor storage is that provided the shed is well sited, the trailers and lorries will have easier access, and in some cases the lorries can be loaded inside. The drier conditions in a store are likely, also, to keep down the losses from soft rots, and even blighted tubers usually dry out to the condition known as " dry blight ".

True, shrinkage of the tubers is usually slightly greater indoors than in the clamp, but since the drier conditions minimize rotting, the one may compensate for the other. Shallow storage (6-8 feet) should suffice for crops likely to be cleared by the end of March or early April, and deep storage (10-12 feet) if they are likely to run on to June or July.

Heavy capital expenditure on new buildings for bulk storage need not necessarily be a deterrent; you may have a building already which, with a little adaptation, would be ideal for the purpose.

CAULIFLOWER MOSAIC IN EAST KENT

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The results of trials in East Kent indicate that the spread of Cauliflower Mosaic in a winter cauliflower crop is frequently due to planting out infected seedlings. At the moment, the use of barrier crops of barley appears to be the best way of protecting the seedbed from the virus.

IN the two years 1948 and 1949, Cauliflower Mosaic, a virus disease, so reduced the yield of saleable winter cauliflower (broccoli) in East Kent that a number of growers intended to abandon the crop should a third failure occur. This did not happen and, in fact, the disease dwindled to negligible proportions in the next five seasons, although it is a matter for conjecture whether such an epidemic is likely to recur.

The growing of winter cauliflowers has long been an established practice in the market gardens of the Ash district of East Kent, but it was not until the middle of the 1930s that the crop was adopted by the arable farmers of the Isle of Thanet. Nowadays, however, East Kent is one of the two most important areas of production. Until 1948 it seems that diseases and pests of cauliflowers caused relatively little loss to Kentish growers. Nevertheless, isolated instances of Cauliflower Mosaic were recorded, and in April 1944 it was noted that nearly all plants in an 8-acre field at Birchington of the varieties Satisfaction and Whitsuntide were showing symptoms of this virus disease.

During the spring of 1948 it was clear for the first time that Mosaic was not only causing leaf mottling, but was also responsible for reducing the size and quality of curds. The disease reached a climax in 1949, when there were few growers who did not suffer substantial losses. Curds were again much poorer than usual, and this time many plants also died prematurely. The experience of one grower, whose return from cauliflower sales was reduced by 70 per cent, was typical.

The first symptom of Cauliflower Mosaic—a translucence of the veins—is likely to be overlooked by the farmer. More obvious is the breaking up of the normal green colour of the leaf into light and dark zones; commonly, there is a dark green band on each side of the vein with lighter green areas between, or the leaf may have a uniformly mottled appearance. Leaf symptoms may fade in summer and reappear in cooler weather. In some areas, severe stunting or death may follow early infections. Infected plants are particularly liable to injury by frost, for a cold spell will cause the lower leaves to fall and, because of the reduced size of the inner leaves, so expose the curd. No variety has yet been found to be immune, but there is evidence that some are able to withstand the disease better than others. Detailed descriptions of these symptoms have been published elsewhere [1, 2].

Practical Control Measures Although East Kent was comparatively free from diseases before the two critical years mentioned, Mosaic had been recognized as a major problem in cauliflower growing in Cornwall and Devon before 1938. In that year, an investigation of the disease was started by workers at University College, Exeter, and the results of the work of several years were published by Caldwell and Pren-

tice [2, 3]. It was not known how far the means of prevention advocated by these workers was applicable to the disease in Kent, but they were adopted as an interim measure until more information could be gained on local conditions. At a meeting of growers in January 1950, Dr. Prentice emphasized the necessity for eliminating all types of brassicas which might carry over infection from one cauliflower crop to the next. As a result, more attention than hitherto was given to the prompt destruction of the remains of harvested crops of Brussels sprouts and autumn cauliflowers, and also of all unwanted plants which were possible carriers of the disease. Equally important was the general agreement among growers to abandon the production of winter cauliflower seed after existing contracts were completed, for seed plants remain in the ground for about 18 months and are long-standing reservoirs of the virus.

There can be little doubt that the readiness of growers to adopt these measures has been a factor in the decline of the disease during the last few years.

Caldwell and Prentice also stressed the importance of avoiding early infection, particularly in the seedbed. Not only did early infected plants serve as centres for the further spread of the virus, but they produced unmarketable curds. When plants were not infected until after planting out, they were more likely to produce a marketable curd. These investigators found that seedbeds close to hedgerows increased the chance of infection of the seedlings; to overcome this, they recommended that seedbeds should be sited in the middle of the field.

Following the lead given by the West Country investigation, it was decided to find out whether healthy seedlings were of equal importance in East Kent and, if so, how they could best be produced under local conditions. To this end, plot trials were arranged in 1950 and in subsequent years. The full results of these trials, together with similar trials in other parts of the country, will be published elsewhere, but certain aspects of the investigation in East Kent are thought to be of sufficient interest for an outline to be given here.

Trials on Seedbed Infection It was of fundamental importance in the trials to expose the plots to conditions similar to those experienced by the nearby commercial crops, and the value of the results depended upon suitable conditions for the spread of the disease. In the four years during which the trials took place there was an annual decrease in the spread of Mosaic in East Kent, so that in relating the results to those which might be expected in epidemic years, some reserve is necessary.

In 1950, the plots were designed to compare the amounts of Mosaic occurring throughout the season in plants from uninfected sources with those from commercial seedbeds and seedbeds protected by a crop which might act as a barrier to the entry of virus. Seedlings were therefore raised: (a) under aphid-proof net cages; (b) at a N.A.A.S. experiment station in Wales where conditions were unsuitable for spread of virus; (c) in seedbeds in Thanet surrounded by kale; and (d) in commercial seedbeds in Thanet. Several plots of plants from each seedbed were planted out on farms at Birchington and Margate on June 27 and July 21 respectively. In all, there were 384 plants of each of the four groups on each farm.

The first of the weekly inspections was made six weeks after planting, when it was expected that any seedlings which had become infected in the seedbed would have had time to develop definite symptoms. The total number showing signs of the disease was small, but the order was the same on both farms:

Source of Seedlings	No. showing Mosaic	
	Birchington	Margate
Commercial seedbed	5	10
Seedbed in kale	2	4
Welsh seedbed	1	0
Seedbed under cages	0	0

Inspections were continued until harvest (April 1951), and during this period the disease spread slowly in all plots. The order of infection, however, remained the same:

Source of Seedlings	Percentage Mosaic at Harvest	
	Birchington *per cent*	Margate *per cent*
Commercial seedbed	11	13
Seedbed in kale	9	11
Welsh seedbed	8	8
Seedbed in cages	5	5

A similar trial was conducted the following year (1951), but conditions were so unfavourable for the spread of the virus that, of the 3,070 plants in the plots, only 14 had shown symptoms of Mosaic by harvest time. Accurate comparison was therefore impossible.

Barrier Crops give Protection In 1950 and 1951, kale was the only plant used to protect the cauliflower seedbeds from virus-carrying aphids. It was thought possible that the insects would be attracted by this cruciferous crop and would either remain on it or would lose the virus before passing to the cauliflower seedlings. The evidence from the Kentish trial in 1950 and from elsewhere supported the view that kale was partially effective as a barrier. In the meantime, comparative tests at Rothamsted had indicated that a barrier comprising rows of cereal plants was even more effective. Accordingly, in 1953 a controlled trial was designed to test the relative effectiveness of four different barrier crops.

The trial was laid down at Richborough, Kent, on a site remote from other brassica crops. Each plot comprised five 8-feet rows of cauliflower seedlings surrounded by three rows of the barrier plants, and Mosaic-infected cauliflower plants were placed between duplicate sets of plots. A count of the number of seedlings showing Mosaic was made on August 11, about six weeks after the date on which they were considered to be ready for transplanting and when any symptoms which had developed would still be considered the result of infection in the seedbed. Even though the infector plants had been scattered with aphids to increase the likelihood of virus spread in a year when the natural aphid population was low, relatively little Mosaic appeared in the seedlings:

Barrier Crop	Percentage Mosaic (average of 2 plots)
None	7.0
Kale plus systemic insecticide	3.9
Kale	3.1
Beans	2.2
Barley	1.1

No firm conclusions may be drawn from the small difference in percentages of Mosaic among the seedlings within the barrier rows, but the relatively high percentage in the unprotected plots shows a trend in the expected direction.

No statistical trials were undertaken in 1954, but several growers were prompted to divide parts of their seedbeds with rows of barley. Six weeks

after planting no symptoms of Mosaic could be seen in any of the plants derived from protected or unprotected parts of the seedbeds, and it was therefore presumed that no infection had occurred before planting out.

Complementary to these field trials, some other field experiments, designed by Dr. Broadbent of Rothamsted as part of a national investigation, were laid down in Thanet in 1951 and 1952 to trace the pattern of spread from single diseased plants. It was clear from the results of these additional trials that most virus infection came from the diseased plants within the plots, rather than from sources outside the field.

Spread by Aphids The aphids occurring most commonly on brassica plants are the Peach-Potato aphid, *Myzus persicae*, and the Mealy Cabbage aphid, *Brevicoryne brassicae*, and these two are probably the most important carriers of Cauliflower Mosaic virus from plant to plant. Other kinds of aphid not breeding on brassicas can transmit the virus and could in their wanderings carry it among broccoli plants, but in East Kent they are normally much rarer on broccoli than are *M. persicae* and *B. brassicae*.

In 1950, the year of the first experiments at Birchington and Margate, winged *M. persicae* appeared in the seedbeds in the third week of April, as soon as the seedlings were up, and the numbers of winged aphids and the proportion of infested plants rose with increasing rapidity to a peak early in June at Birchington and three weeks later at Margate. Numbers then fell to nil by the end of July, after planting out, and rose slowly through August to a second and much higher peak in September and October. *B. brassicae* arrived later, in the last week of May, reaching a peak early in June. Thereafter the pattern was similar to that for *M. persicae*.

That the lower incidence of Cauliflower Mosaic six weeks after transplanting the seedlings raised under cages, in Wales, and in plots surrounded by kale, was due to their protection from infective aphids, was shown by the differences in aphid infestations of the seedbeds at both Birchington and Margate. At the June peak 89-98 per cent of the plants in the commercial seedbeds were infested with either or both species of aphid, while those under cages and in Wales were free, and those in kale were intermediate, having 55-60 per cent infested. The two seedbeds in kale were much smaller than the commercial ones, and their aphid infestations only reached one-tenth to one-fifth of those of the surrounding kale, which, having been sown about a week in advance, was always slightly taller. During September and October practically all the plants in the plots became colonized, but further spread of virus, as shown by symptoms developing in the following spring, was relatively small.

It is noteworthy that in May and June of 1950 *M. persicae* was plentiful on old broccoli crops near the Birchington plots, and there were large colonies of *B. brassicae* on spring cabbage in nearby allotments. The incidence of Cauliflower Mosaic in these crops was also high, and there was a moderate aphid invasion of the seedbeds. By contrast, from 1951 to 1954 no overwintering aphids were found in the spring on old broccoli crops, and seedbed colonization was extremely low, the infested plants rarely exceeding one per cent. Summer colonization was very slight in 1951, and moderate in 1952-54, when in August some 70-90 per cent of the broccoli plants were infested with small numbers of aphids. During these years the chances of seedbed infection were very slight, and the summer spread of aphids was evidently not sufficient to raise the incidence of Cauliflower Mosaic from its low level of 1951. In 1947 and 1949, on the other hand, aphid infestations

were exceptionally severe, and it is likely that this was an important factor in the epidemics of the disease in 1948 and 1949, bringing about a high rate of seedbed infection and further spread after transplanting. Why aphid populations subsequently fell so low is unknown, but the recurrence of epidemic aphid years might restore the disease to a dangerous level, especially if, at the same time, there should be a resumption of the growing of seed crops, which would increase the sources of infective aphids in the spring.

Need for Healthy Seedlings The evidence from these field experiments in East Kent and elsewhere indicates that, in non-epidemic years at least, the planting of uninfected seedlings leads to a healthier crop throughout the season. But since the conditions during the years of the experiments were unfavourable for virus spread, it is not possible to say how far the losses of 1948 and 1949 would have been reduced had only healthy seedlings been used. Account must be taken of other sources of the virus, such as the long-standing broccoli seed plants and nearby crops of the cabbage family which may also harbour the virus. But although these are undoubtedly important sources of virus infection, it is doubtful whether they are as efficient foci of spread to a planted out crop as the scatter of diseased seedlings which is usually introduced from a commercial seedbed.

Many growers now isolate their broccoli within the limits imposed by the types of crops surrounding them. Less attention has been paid to the problem of obtaining healthy seedlings. The most direct method of achieving this would be to have them raised in areas where brassicas are not grown and where conditions for the spread of viruses are known to be unfavourable; this method is to be strongly commended if another build-up of the disease is foreseen.

Because of the extra cost and inconvenience of buying in plants, nearly all growers expect to raise seedlings on their own holdings. A means of protecting seedbeds from surrounding sources of virus is therefore necessary. At the present time, the use of barrier plants has shown more promise than any other device. Since Caldwell and Prentice published their recommendation, a number of growers have sited the seedbed within a cereal crop, and this has probably given a measure of protection, although it is doubtful whether the protection extends to a width of more than 20 rows. A more efficient plan is believed to be the division of the seedbed by rows of barrier plants at frequent intervals. However, the best arrangement is yet to be evolved, and further experiments with barley as a barrier crop are envisaged.

Thanks are due to Messrs. U. E. K. Fraenkel, A. G. Walker, J. J. Walker, H. J. Gould, M. E. John and W. I. St. G. Light, who collaborated with us in these investigations, and to several farmers in Thanet who gave facilities for the plot trials.

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Appointment in Canada

Mr. Gilbert S. Lawrie, B.Sc.(Agric.), N.D.A., has been appointed Agricultural and Food Adviser to the High Commissioner for the United Kingdom in Ottawa in succession to Dr. W. F. Darke.

ASPERMY VIRUS AND FLOWER DISTORTION IN CHRYSANTHEMUMS

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Aspermy virus disease is widespread in this country. The infection is spread by aphids or by propagating infected material, but the position is considerably aggravated by the reluctance of growers to rogue and destroy affected plants as soon as the first symptoms appear.

IT has become increasingly clear in recent years that flower distortion is a widespread problem in chrysanthemums. Some flower irregularities result from Capsid damage in the bud stage, or from rough handling at disbudding, but the great majority of distorted blooms are due to virus infection. Aspermy, which is probably the most common virus in chrysanthemum stocks, has been recorded from all parts of the country, and in a large number of varieties. Some of the most popular varieties are very heavily affected—for example, the Sweetheart, Favourite and Harrison groups. Stocks of Sweetheart varieties are particularly bad, this being emphasized by the obvious and very severe flower symptoms shown by infected plants of this group.

All varieties of chrysanthemum tested have proved susceptible to infection, but symptoms vary greatly, not only in different varieties and between different plants of the same variety, but also between different flowers on the same plant. Red, bronze and pink flowered varieties frequently show bleaching or colour-breaking—that is, flecks and lines of a paler colour on the ray florets; for example, pale grey on Purple Prince, bright yellow on Shirley Late Red, whitish on August Pink, and so on. Where it occurs, colour-breaking is probably the most reliable symptom for the diagnosis of Aspermy infection. White and yellow varieties, however, normally show no colour changes. The amount of flower distortion ranges from severe twisting, tubing and irregularity of the ray florets, to a slightly untidy appearance. Some varieties, such as Yellow Wallace, show no symptoms when infected; others, such as Market Gold, respond to extra applications of nitrogenous fertilizer by producing only slightly affected blooms, compared with the tightly packed, "quilled" florets seen in infected plants under normal levels of feeding. Lopsidedness and asymmetry of flowers, or failure to open evenly, is not usually due to virus infection.

Aspermy does not normally produce leaf symptoms, although there may be slight general chlorosis or paleness for a few weeks in early spring on the young leaves of some varieties. Chrysanthemum plants showing various leaf mottles have always been found to be infected with other viruses, of which there are at least four that are widespread in chrysanthemum stocks. Some of these can be carried symptomlessly by a number of varieties, but show definite leaf or flower symptoms in others. Many chrysanthemums are infected with more than one virus, and in such cases symptoms are often severe; most of the more destructive symptom types have been found in plants infected with two or more viruses of this complex, of which Aspermy is frequently a member. Green coloured florets, especially in the centre of the flower, is one characteristic symptom resulting from complex infection.

Although an infected plant does not recover, and all cuttings from it are diseased, an important feature of Aspermy is that current season infections

usually affect only a proportion of the blooms the same year; plants infected in September or later showed only one or two distorted flowers that year, though most of the other flowers contained the virus. In subsequent seasons, cuttings from such plants produced an increasing proportion of abnormal flowers and increasing severity of symptoms. Although cuttings from infected stools tend to root a little more slowly than those from healthy stocks, and though the subsequent vigour of infected cuttings is slightly less than normal, these differences are insufficient to be of diagnostic value.

Plants that can be Infected A wide range of plants has been experimentally infected with Aspermy virus, but so far the only ones that have been found naturally infected are chrysanthemum, tomato (in which the virus was first found), China aster, and zinnia. Most of the outbreaks of Aspermy in tomato plants have been in the south-west, the disease being less common on the crop elsewhere. Even so, it is unwise to grow chrysanthemums and tomatoes in the same glasshouse, because each can act as a source of infection for clean stocks of the other, not only in the case of Aspermy virus, but also for Tomato Spotted Wilt.

The symptoms of Aspermy on tomato vary with the strain of the virus and the variety of tomato; in general, the tops develop a pale green colour (apical chlorosis) two to four weeks after infection, and this is followed by varying severity of leaf mottling and leaf distortion. The distortion may be merely a slight lack of symmetry, as in Sutton's Harbinger, or a moderate amount of twisting and distortion, as in Morning Sunrise and Kondine Red, up to extremely severe tendril-leaf formation, as in Britain's Best. Growth of the stem tip is nearly always stopped, leading to excessive branching and an abnormally bushy habit. Flowers appear normal, though there are fewer of them, and less fruit is set than on healthy plants. Moreover, the fruit shows a great reduction or complete absence of seeds—a characteristic symptom from which the disease Aspermy derives its name. The word, in fact, means "no seeds". Infected plants do not recover, yield little fruit, are severely stunted, and are sometimes killed.

A few weeds, such as sow thistle, groundsel, black nightshade and wall lettuce (*Lactuca muralis* (L.) Rchb.), have been experimentally infected with some strains of Aspermy virus, but, despite a number of tests, no natural infections have so far been found. The danger from weed hosts acting as a virus reservoir is negligible compared with the large amount of infection known to exist in chrysanthemum stocks. Nevertheless, a number of ornamental pot and bedding plants are highly susceptible to infection, including petunia, salpiglossis, cineraria, annual chrysanthemum, pyrethrum, marigold, helichrysum, primula, lobelia, phlox, anemone, forget-me-not, and green pepper. One strain of the virus also infects lettuce and nasturtium. Fortunately, dahlias are apparently immune from infection.

Spread by Aphids Aspermy virus is spread from plant to plant by aphids. Nearly all the species of aphid infesting chrysanthemums can transmit this virus, and only short feeding periods (less than two minutes) on both diseased and healthy plants are necessary for its transmission. Young cuttings provide both the best source of virus and the most susceptible stage for infection, so that aphid control in the early months is most important. As the plant matures, its susceptibility to infection becomes less, while in plants already infected the virus concentration declines. It is frequently very difficult to isolate the virus from older leaves, but if such leaves are detached and rooted in sand, the resulting plants have always been infected. Contact between leaves of adjacent plants does not spread the disease, but it does make it easier for aphids to move from plant to plant.

Normal handling and propagating methods, including contamination of the cutting knife, cause very little spread of Aspermy virus, but root contact, where two or three plants are grown in a large pot, can result in spread of infection to other plants in the same pot. Spread of infection by root contact may also occur where chrysanthemums are bedded out. There is no evidence of seed transmission, and no infection has occurred when plants have been grown in compost previously used for diseased plants. For all practical purposes, spread is by aphids and by propagating infected material. Certain "novelty" varieties have been found 100 per cent infected: the "sports" were, in fact, plants with rather mild and pleasing symptoms which were being propagated!

Select and Rogue Control must be based on selection, roguing and prevention of aphid infestation. Throwing away plants or discarding entire stocks of a variety is heartbreaking, and many growers are reluctant to remove mediocre plants which, though infected, may in some varieties give one or two saleable blooms. But the only long-term solution for badly affected varieties is to propagate fresh stocks from a few stools selected at flowering time for vigour and quality of flowers, and to discard the rest of the stock as soon as possible. Selected stocks for propagation should be labelled, so that if, due to a late season infection, the mother plant develops symptoms later in the year, its progeny can be traced and rogued. These new stocks should be propagated away from the main stoolbeds, preferably in a smaller house reserved for the purpose. Weekly fumigation should be carried out, and if possible, muslin gauze tacked over the ventilators to exclude aphids. This should enable a very high proportion of virus-free plants to be raised, and ruthless roguing should maintain the health of the stock.

Whatever the merits of rested stock, the presence of such stools is a potential danger to other stocks, as only at flowering time can Aspermy be diagnosed and roguing satisfactorily carried out. Newly-purchased stocks should be "quarantined" away from other stocks until flowering time, when roguing and selection can be done. Since midseason infections often affect only a proportion of the blooms in that year, the presence of several normal-looking flowers on a plant with only one or two blooms showing symptoms may be a temptation to retain it instead of roguing, but it cannot be too strongly stressed that such a plant is another focus of infection.

The foregoing information is based on work carried out in the Ministry's Plant Pathology Laboratory over the past four years, and it applies primarily to Aspermy virus. But much is equally applicable to the control of some of the other viruses of chrysanthemums. Their means of spread is still being investigated, though one at least (virus b) is transmitted by aphids. Roguing of the leaf-mottling viruses, however, is best carried out in spring, when symptoms are most clearly shown. Those varieties which carry viruses without visible symptoms complicate matters. As more information is available, selected and virus-tested stocks of such varieties might be propagated to replace existing stocks, and heat therapy may offer practical possibilities in other cases.

Much of the present virus trouble in chrysanthemums is due, however, to the reluctance of growers to rogue and burn all obviously diseased or suspect plants; it is fortunate that the spread of most of the chrysanthemum viruses appears to be relatively slow, so that prompt action may yet prevent complete infection of most varieties.

BIRD MIGRATION

KENNETH WILLIAMSON, M.B.O.U.

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The seasonal migrations of birds have been, and continue to be, closely studied. Why, how and when this phenomenon of behaviour occurs is discussed by the Director of Britain's most northerly bird observatory.

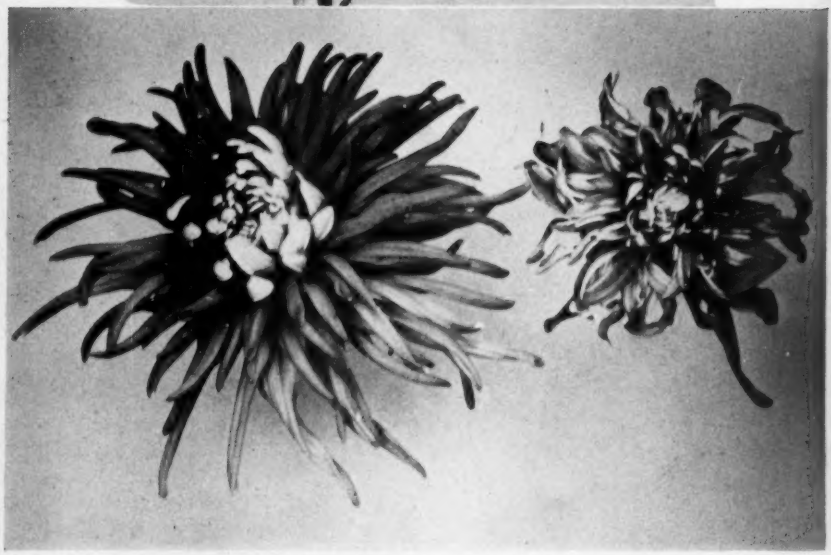
TRUE migration is the seasonal coming and going of animals, guaranteed to secure the best environmental conditions throughout the year. Whilst it is by no means the prerogative of birds, it has been most closely studied in relation to these abundant, ubiquitous and exceedingly mobile creatures. Nevertheless, we should not forget that regular migrations of considerable extent are shown by many other animals, among them seals, whales, eels, salmon, and even man himself. The Norwegian peasant who moves his household from the fjord to the mountain *saeter* in order to exploit the summer grazing, returning before the onset of the winter snows, performs a migration in exactly the same sense as the swallows which nest under the roof of his byre and fly at the summer's end to Africa.

These alternating movements may be between regions of the ocean affording an abundant food supply and an area of land suitable for breeding, as in the case of fur-seals and phalaropes and very many sea-birds; or they may be between freshwater streams and oceanic spawning-grounds, as with the eels; or the reverse, as with the salmon. It is the regularity of these movements which distinguishes true migration from the periodic mass "irruptions" which take place among certain birds, such as the Crossbill; insects, such as the locust and some butterflies and moths; and mammals, such as the lemming. In these cases of irregular migration, especially favourable conditions may lead to an acute overcrowding in the breeding area, and this is followed by a large-scale exodus during which some of the population may succeed in pioneering new territory. But although both types of migration are directed at securing an adequate food supply, in the case of the mass "irruptions" there is seldom a corresponding return movement on any appreciable scale.

Timing Migration in birds is thus primarily related to securing the best available food supply at a particular time, and there can be little doubt that the behaviour originated to meet this end. That this is the ultimate cause does not necessarily mean that it remains the proximate factor stimulating each fresh burst of migratory activity; and, indeed, it is a commonplace observation that in most cases birds begin their journeys long before the food

Photo : *J. Peterson*

The Fair Isle Bird Observatory



Aspermy Virus and Flower Distortion (article on pp. 275-7)

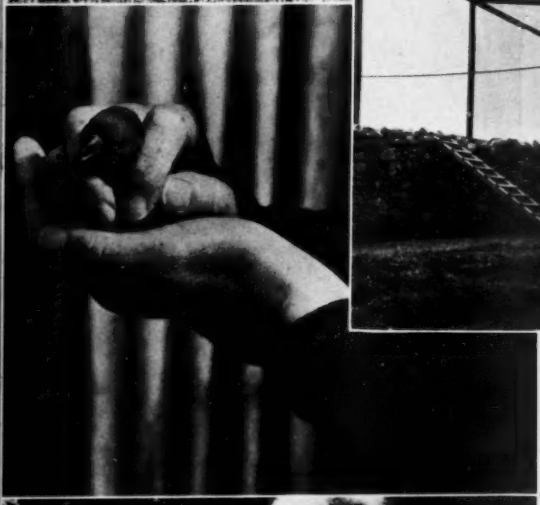
Aspermy virus on tomato. Growth of the stem tip is nearly always stopped, leading to excessive branching and bushy habit.

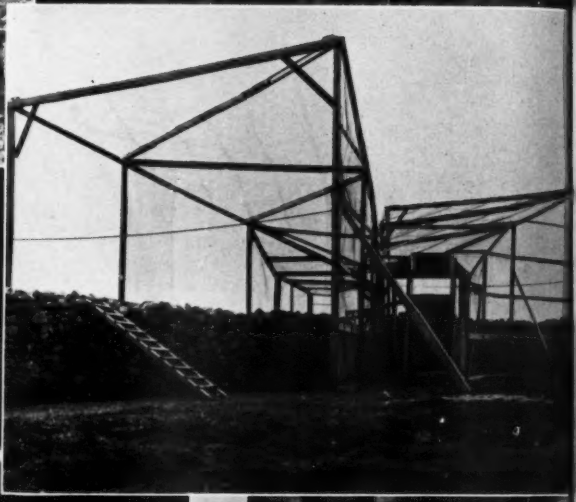
Severe distortion on chrysanthemum (var. *Shirley Late Red*) caused by Aspermy.

Photos: *P. R. W. McKergow*

Dairying in the Pennines (article on pp. 262-6)

Top The industrialized valley of the Colne
Centre Farm A, a 60-acre all-grass farm at 900 feet
Bottom Farm C, a 42-acre farm at 550 feet





shortage in the breeding or wintering ranges becomes acute. The great precision in the timing of true migration can be better understood when one realizes that the behaviour is a vital part of the seasonal cycle of the bird's life, and, like breeding and the moult, can be prosecuted only when physiological changes have prepared the bird for the experience. Sir Landsborough Thomson has put forward the conception of an annual physiological cycle, established as an inherent rhythm, controlling the timing of these major activities of a bird's life, and deriving their immediate stimuli from environmental changes. The exact nature of its stimuli is not fully understood: decreasing day-length in autumn (reducing the available feeding time), temperature changes (rising in spring, falling in autumn), and changes in barometric pressure may, separately or cumulatively, influence migration. Some of the recent work in this field suggests that the last of these phenomena may play the most important part, but indirectly through its effect on wind strength and visibility. This is a point to which I shall return later.

Even among closely related birds, migration may be manifested in remarkably different ways. Thus among the willow-warblers of the genus *Phylloscopus*, the Arctic Warbler journeys from Lapland to Siam, whilst the Siberian Willow-warbler travels from the Kolyma River to Kenya, their 7,000-mile routes crossing at right-angles. In contrast, many of the Himalayan willow-warblers migrate altitudinally, finding their seasonal habitats at different levels on the foothills and steep mountainsides; and there are a few of the genus, such as the Canary Islands races of the Chiffchaff, which are entirely sedentary. Wild geese travel in tribal flocks and remain together throughout the winter, the survivors returning in flock to their nesting-grounds in Greenland, Spitsbergen and northern Europe in spring. When the Icelandic Whooper Swans reach Shetland in October we find they come, and stay, in discrete family parties. No such bond exists among the ducks, however. In this group pairing takes place in winter quarters, and this gives rise to a peculiar movement known as "abmigration", in which local birds pair with a visitor from far afield, and may travel hundreds of miles from their native heath to breed.

Although the geese and swans show their young the way, this is the exception rather than the rule, and in many species the young of the year migrate before the adults, whose departure is delayed until the completion of the annual moult. There are species, such as the Gannet, in which the migration habit persists only for the first few years of life. The young Cuckoo, which can never know its parents, must find the route to Africa entirely on its own; and the young of the New Zealand Bronze Cuckoo have an even more miraculous pathfinding to perform, for they are known to winter only in the Solomon Islands and Bismarck Archipelago across water gaps a thousand miles wide.

Bird Migration

The South Lighthouse on Fair Isle attracts many night-flying birds. The gully and the double-dyke traps enable accurate observations to be made and records kept. The centre picture shows a Crossbill. (*Below*) a young Arctic Skua, ringed for identification, and (*right*) a Greenish Warbler, a rare visitor to Britain.

Astonishing Journeys There are many other astonishing journeys, some of which may arise from the fact (suggested by Mayr) that migration is a back-tracking of the route of immigration to an area. The Arctic Terns of Cape Cod, Massachusetts, cross the North Atlantic to Europe before migrating to South Africa—perhaps the longest journey of which we have any record. The Greenland Wheatear, which has invaded the Canadian arctic, still journeys to and from Africa by way of the British Isles. Siberian birds, which have forced the Bering Straits and now breed in Alaska—a Bluethroat, a Yellow Wagtail, the Willow-warbler and Wheatear—retrace their immigration route at the end of the breeding season, whilst two American song-birds, which have colonized the Anadyr region of Siberia, cross to the New World. The Great Shearwaters, which roam the North Atlantic in the late summer months, have no difficulty in finding that pin-point of land, Tristan da Cunha, their only known breeding-place, in February and March; and the same colour-ringed individuals of the Arctic Skua rendezvous with their mates on precisely the same moorland territories of Fair Isle year after year, after wintering in the southern ocean. These, and a thousand other cases, postulate an accurate navigational instinct in migratory birds.

The species mentioned above are wholly migratory, but many others show considerable variation in the extent of the performance. Some of our more familiar British birds, such as the Song-thrush, Blackbird, Pied Wagtail and Lapwing, are "partial migrants" only. That is to say, a proportion, mainly from the northern districts of the country, move a short distance south-west into Ireland or even France, whilst many of their neighbours, predominantly from more southerly localities, stay at home. It is likely that this habit of "partial migration" is not fixed in particular individuals, their behaviour varying from year to year, for we have several records of Blackbirds, and one of a Long-eared Owl ringed whilst on passage through Fair Isle, being found wintering in Scandinavia in a subsequent year. Very often such "partial migration" is set in motion in a normally non-migratory stock by excessively severe weather.

Night and Day Migration One of the most remarkable features of this biennial coming and going of vast numbers of birds is that so many make their journeys during the hours of darkness, because they must reserve the daylight for finding food and replenishing lost strength. Generally speaking, the insectivorous birds, such as the warblers and thrushes, are nocturnal migrants, whilst the seed-eating finches and buntings—and also most birds of prey—move by day. However, no hard and fast line can be drawn, and in this respect very much depends upon local conditions of weather and food supply. The day migrants are at a distinct advantage, for recent experiments by G. V. T. Matthews in England and Gustav Kramer in Germany have shown that birds are able to orientate in their "preferred direction" (which in northern Europe may vary between south-west and south-east in different species, and even in different geographical communities of the same species) by observation of the position of the sun. This ability means that the bird must have some timing mechanism which takes note of the diurnal movement of the sun across the sky, and the nature of this "internal clock" is a mystery which students of navigation are at present trying to probe. So long as the sun is visible, or there is little cloud in the sky, the day migrants can find their way; but if its light is obscured by heavy cloud, or by the mist and drizzle which accompany frontal weather, their navigational sense is impaired. It is not known whether night migrants have some compensating directional sense dependent on moon

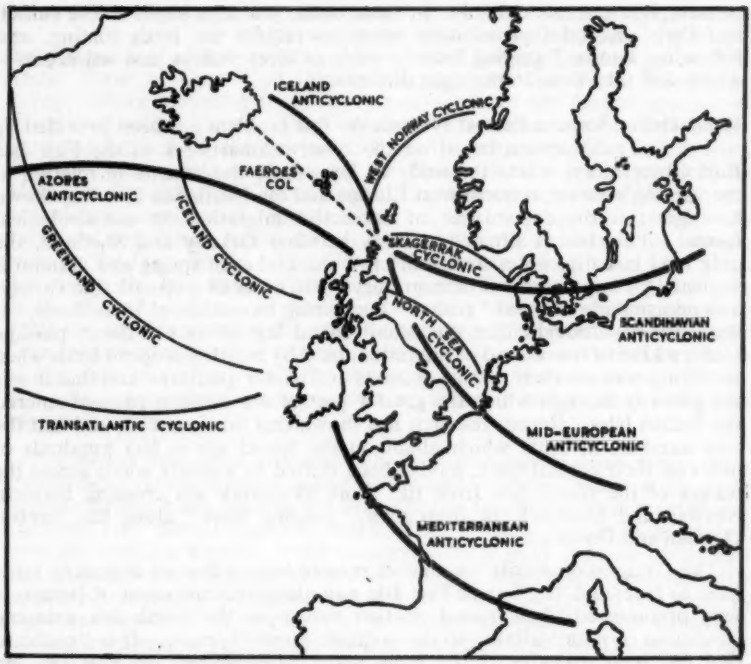
or stars, but it seems unlikely: in these birds, journeys begin before sunset, and their successful prosecution seems to require the birds finding, and following, known "guiding lines"—such as river valleys and sea coasts—which will take them in the right direction.

Wind Drift Some collateral evidence on this problem has been provided by deductions based on the observational work at the Fair Isle Bird Observatory, where the study of large-scale movements in relation to the varying weather in north-west Europe and the North Sea area has shown how great is the dependence of successful migration on meteorological factors. Fair Isle is situated midway between Orkney and Shetland, the only land in a fifty miles stretch of open sea, and each spring and autumn it is visited by large numbers of migratory birds, often of a remarkable variety, and occasionally in great "rushes" numbering thousands of individuals. It was formerly thought that this small island lay athwart a direct passage route, a kind of trunk-road of migration, used by North European birds when travelling between their nesting-grounds and winter quarters—and that it was the gateway through which the greater part of our autumn passage entered the British Isles. Recent research has shown that this is not so, and that the vast numbers of birds which alight on the island are in fact hundreds of miles off their normal track, having been drifted by easterly winds across the wastes of the North Sea from the short Skagerrak sea crossing between Norway and Denmark, or from their "guiding lines" along the Danish, German and Dutch coasts.

This "migrational drift" is an ever-present hazard that all migratory birds have to face, and its effect at Fair Isle and along the east coast of Britain is very pronounced when frontal weather sweeps up the North Sea, bringing conditions of poor visibility to the migrants' normal course. It is significant that the great majority of the birds borne adventitiously to Fair Isle are nocturnal migrants, these being especially susceptible to sudden deterioration in the weather. We see comparatively few day migrants, for these are able to offset wind-drift away from their charted course by visual means.

Adverse wind is the migrant's implacable enemy, and it is not surprising that there is a growing mass of evidence in the Fair Isle records that migratory flights are set in motion by anticyclonic weather. For at the heart of an anticyclone there is none or very little wind and skies are usually sunny and clear—a halcyon situation which may continue over a wide expanse of the Continent for several days. Such optimal conditions may reduce, but they do not exclude, the risk of drift; for there is an east-west circulation of air on the southern side of every high-pressure zone in the northern hemisphere, and coastal mist or fog not infrequently mars anticyclonic weather. "Migrational drift" is sometimes evident on an immense scale when an autumn high develops over northern and central Europe, and the great "falls" of night migrants along our eastern seaboard emphasize the importance of the anticyclone as a releaser of migratory activity. Whether caused by low pressure or high, "migrational drift" explains why British bird-watchers annually record rare vagrants from half the world over—American waders and even small land-birds gale-driven down the Atlantic storm track; Mediterranean birds misdirected across the Bay of Biscay and St. George's Channel; and Siberian warblers, such as the Greenish and Yellow-browed, or pipits, such as Richard's and the Petchora, carried relentlessly westwards by night in the easterly airflow of the continental highs.

The autumn migration which British bird-watchers are now following with interest is not, therefore, an event which follows a set pattern from year to year. The volume and extent of the passage is largely determined by the



Map showing the main approaches of our autumn migrants and rare vagrants. The names accord with the pressure patterns creating the down-wind drifting which is responsible for much of the passage-migration through Britain.

nature of the weather over north-western Europe and the North Sea. The pattern of bird migration through Britain is as unpredictable as British weather, for, despite their amazing powers of navigation under optimal conditions, the behaviour of the birds is very often the behaviour of the medium through which they travel.

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A CASE OF ARSENICAL POISONING

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This step-by-step account of an investigation into a number of deaths among milking cows on a Welsh farm points to the scrupulous care necessary to ensure that both farm animals and their food are isolated from substances known to contain arsenic.

LEAD is the most common cause of poisoning of cattle by inorganic substances in the area of mid-Wales covered by the Aberystwyth Veterinary Investigation Centre. It is met with most frequently in calves, and occurs so often throughout Britain that in most veterinary investigation centres an examination for lead is routine where sudden death has been reported. The sources of lead available to domestic animals most commonly include red lead, lead paints, car batteries and linoleum.

In this area, however, arsenic follows closely upon lead in order of frequency as a cause of farm stock poisoning. Since arsenic is not now used to any extent in dips, poisoning following sheep dipping is no longer as common as it used to be. But nowadays arsenic does compete with copper sulphate as an ingredient of foot rot baths, and as such sometimes causes poisoning. This generally results from carelessness on somebody's part in forgetting to close a gate, thus giving the animals access to the material left in the foot bath. The diagnosis of arsenical poisoning is made easier if the sources of the poison on the farm are known. If this information is not available, the tracing of the point of danger may be extremely difficult, and indeed it may not always be possible to complete the picture, even though the cause of death has been established. The incident described here provides an interesting example of the type of detective work that is sometimes called for, but primarily it points to the absolute necessity for keeping stocks of any materials containing arsenic well out of the way of livestock.

Poison is Diagnosed Recently we had a call at this laboratory from a veterinary surgeon asking for help in investigating the reason for a number of deaths in a herd of Welsh Black cattle. The history revealed that the losses were confined to the cows, but that a high proportion of them were affected, that the symptoms appeared roughly about the same time, that they were essentially similar in all the animals affected, and that the victims did not include any cows suckling calves. In other words, only those cows which had been milked in the milking parlour were affected. The symptoms shown, invariably sudden in onset, included severe depression, normal or low temperatures, loss of appetite and copious diarrhoea.

A post-mortem examination carried out upon one of the cows over twenty-four hours after its death disclosed a most striking feature about the carcass. In spite of the relatively long time since death, there was no sign of decomposition. As the post-mortem examination proceeded, it became evident that the animal had died as a result of the ingestion of material which had caused extremely severe damage to the interior lining of the stomach and intestines. The history, the symptoms shown by the affected animals, the explosive nature of the outbreak and the post-mortem findings all suggested some form of poisoning by an irritant substance taken in by the mouth.

Arsenic appeared to be the substance most likely to be responsible, with phosphorous as a second possibility. Arrangements were therefore made for a chemical analysis of suitable organs—in this case, the stomach and the liver. At the same time, since a similar picture could result from a severe outbreak of disease caused by germs ingested in food or drinking water, a bacteriological examination was made of certain parts of the carcass.

Believing that the diagnosis was sufficiently firm to warrant an analysis of the food of the affected animals, samples of the purchased foods were also submitted with the post-mortem material to the Ministry's Veterinary Laboratory at Weybridge. All the affected animals had been running out at grass, but their diet included a certain amount of dried brewer's grains and dried grass cubes. Since the dried grass was a product of the farm and had been dried locally, it was thought to be an unlikely source of arsenic, and so only the dried brewer's grains were submitted for analysis in the first instance. But when a telegram was shortly received from Weybridge to say that the stomach contained arsenic but that the dried brewer's grains contained none, a second visit was paid to the farm, and a number of samples of dried grass were taken from such sites as the feeding troughs in the milking parlour, the floor of the granary above, and from a number of sacks in the granary. On analysis, a number of these samples of dried grass were shown to contain arsenic, including those taken from the feeding troughs in the milking parlour.

The Source is Traced For a few days an intensive search failed to reveal a likely source of arsenic on the farm, but eventually the origin of the poison was found—a drum of foot rot dressing lying on a plank connecting two beams in the storage granary. The metal of the drum was eroded around its base and the solution of arsenic was dropping so slowly as to escape detection on to a number of bags of dried grass stored below! The bags of grass immediately below the drum were accordingly taken out and buried, and the remainder were used without further incident.

It became known during our investigation that earlier in the year a number of cows in the herd had suffered from a severe form of scouring after feeding them some corn stored in the same place as the dried grass. It is very likely that this also was the result of arsenical poisoning.

This investigation was satisfactory in the sense that the source of the arsenic was discovered, and here, as in those cases which result from a failure to prevent access to foot baths, it is unlikely that similar cases will again arise from the same cause. But an expensive lesson will have been learned. The occasional case in which the source of the arsenic cannot be demonstrated is a great nuisance and liable to prove even more costly, since no effective step can be taken to prevent further cases arising.

Thanks are due to Mr. S. H. Adams, M.R.C.V.S., who drew our attention to this outbreak of arsenical poisoning, and to the staff of the biochemical department at Weybridge where the analyses were made.

NEW AGRICULTURAL ENGINEERING JOURNAL

A warm welcome is assured for the British Society for Research in Agricultural Engineering's new publication, to be entitled JOURNAL OF AGRICULTURAL ENGINEERING RESEARCH. The first issue of this journal, which is intended to provide an outlet for the publication of original work in the field of agricultural and horticultural engineering, is promised for January 1956. It will appear twice a year. The annual subscription for the British Isles will be 21*s.* (12*s.* 6*d.* for students).

ROUGHAGE FEEDING IN SCANDINAVIAN HERDS

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Greater use could be made in Britain of good quality roughage to save concentrates. Scandinavian practice in this respect is an interesting pointer to possible economies.

ALTHOUGH farmers can now get imported feedingstuffs more easily, there is economically still much in favour of home-grown bulky feeds, such as hay, silage and root crops, to replace some of the concentrates in the ration. In Scandinavian countries, national agricultural policies have demanded an independence of imported concentrates, and farmers' experience there in methods of feeding large quantities of bulky foods to dairy cows extends over at least thirty years.

The extent to which British farmers might gain from Scandinavian experience is amply illustrated by the fact that on many of our farms all home-grown foods, both from grass and fodder crops, are not providing sufficient nutrients even for maintenance alone. To provide for two gallons of milk in winter with bulky foods is unusual. Compare this with the example of a farm in central Sweden where maintenance plus a daily yield of four gallons of milk is provided for entirely by bulky foods, and a further two gallons by a home-grown concentrate mixture. This is an exceptional case, and such a degree of independence of concentrates is not necessarily being advocated. But the farmer in this country who seeks to use more home-grown foods may be interested in some of the principles which farmers in Scandinavia believe are important when feeding a ration containing large quantities of these bulky "roughages".

This applies particularly to the way in which the limit of the cow's capacity for dry matter is overcome, but other questions that must be asked are: (1) whether the breeding and selection in those countries have produced a superior animal for roughage conversion; or (2) if acclimatization of stock to a bulky ration, especially during rearing, is just as important.

Winter Feeding Outlined An outline of the winter feeding procedure in Scandinavia may be helpful. Nearly all the herds are wintered in byres, and the cost of feeding round bulky foods to individual mangers is reduced by giving what is called a basic roughage ration to all cows, no matter what their yield. An example of such a ration from Denmark is 48 lb. fodder beet, 40 lb. swedes, 37 lb. beet top silage and 10 lb. hay. This is fed in one day and, with 4 lb. of a high protein cake, is balanced for maintenance and just over three gallons of milk. This ration contains 31 lb. of dry matter in itself, and for exceptional cows (yielding 7½ gallons a day) an additional 16 lb. of balanced concentrates would require a dry matter intake of 45 lb. We should think this excessive for the Red Danish cow weighing 11½ cwt., but the Scandinavians find that the high-yielding cow has a natural craving to satisfy nutrient requirements. This is expressed as a higher uptake of dry matter which approximates to the following scale:

Increase in Daily Dry Matter Capacity with Daily Milk Yield

Yield of 4 per cent butterfat milk (*gal./day*)	0	1	2	3	4	5	6	7
Dry matter capacity (*lb. D.M./day*)	20-26	22-28	24-30	26-33	34-37	37-39	40-42	42-44

The exception is with heifers which, because they are smaller, cannot manage the full ration of bulky food. They are grouped separately in the byre and receive a half ration of roots. All the cows are grouped according to daily yield, there being one group for every half-gallon increase, which is re-formed fortnightly. This simplifies concentrate feeding for those yielding over the three gallons provided by the basic roughage ration.

Although it has been found easier to encourage a cow to eat a lot of bulk if the food can be given in small feeds during the day, increased wages for stockmen usually make this uneconomic. But the farmer feeding bulks for more than three gallons often finds it an advantage to give an extra feed of hay at midday.

Perhaps a point worth emphasizing more than any is the importance attached to variety in the ration. It is felt that it adds greatly to palatability and so caters for the individual variation in uptake to be expected if large quantities of one food only were offered. This justifies the general policy in Scandinavia of making up the basic ration with as many as four foods, and this is exploited even further in some cases by cutting hay from the barn, and silage from the clamp, vertically from the whole face each day. Thus the daily ration consists of cuts from different crops, taken at different times of the year.

Of almost as much importance is to feed this same ration for as long as possible during the winter. The herd then becomes accustomed to it, both from the point of view of palatability and, longer term, by adjusting the rumen microflora to deal with a ration containing certain proportions of succulents and fibrous material.

Feeding a basic ration of bulky foods obviously eases rationing, but there is also another reason. Towards the end of lactation, cows yielding less than three gallons a day will receive more nutrients than they need. This means that they will gradually be built up in bodily condition for the next lactation, which in itself will save steaming-up concentrates. If any cow in the herd seems unable to cope satisfactorily with the bulky ration, it is moved up one group higher in the byre so that it receives a little more concentrates. It is inevitable, however, that most cows will lose condition slightly during the peak of lactation, but as soon as the level of yield falls below three gallons a day, any loss in weight will soon be regained. In essence, feeding is carried out according to daily yield, but this principle of build-up towards the end of lactation quite simply enables the condition of the herd to be kept up from one lactation to another. Autumn calvers are treated just the same, because as soon as the grass falls away in late summer it is supplemented with beet top silage.

It is amazing the care that is taken in Scandinavia to introduce animals gradually to a roughage ration, or indeed when making any change in the ration. One Danish farmer, when feeding fodder beet, allowed at least a week to change over from one variety to another. They are just as emphatic about keeping a check on the exact quantities of all the bulky foods given, and illustrate it by showing how an error in feeding 5 lb. of concentrates, in mistake for 3 lb., is of little consequence—except for the wastage; but to feed 50 lb. of roots in place of 30 lb. in a high roughage ration might cause considerable upset in the herd, which would be reflected in yields.

Capacity for Roughage Feeding This gives some picture of the winter feeding routines followed in Scandinavia. There remains the question whether the native breeds of cattle there have benefited from selection towards the type of animal most suited to the utiliza-

tion of bulkier foods. Without doubt, the deep flanked cow with a well-developed girth is preferred; and indeed the Finnish, the Swedish Red and White and the Red Danish breeds are much deeper-bodied than most of ours. But it has yet to be substantiated that there is any direct correlation between girth development and the cow's ability to use greater quantities of bulky feeds. Work is in progress to assess the importance of girth character in combination with the bull progeny testing schemes in Sweden and Denmark.

At the bull testing stations in Denmark, a bull's unselected daughters are kept under most stringently controlled conditions, and bulky foods are fed for maintenance and two gallons of milk. Precise information can be collected, not only on milk and butterfat yields but on efficiency of food utilization, and this is being extended to include other economic points such as the speed of milking, conformation of the udder, shape of lactation curve and the measurement of girth. In Sweden, using a similar testing method to that of our own Milk Marketing Board, a greater number of daughters are tested in the conditions of their own herds. In this case, a recorder will be sent round to all these herds in an attempt to appraise the same economic points and so determine which influences can be attributed to the bull and which to management.

Before we hear of the trends from these studies it would seem that if these breeds do possess any superiority over our own it has been reached comparatively recently. It is only since the period between the two wars that Sweden and Denmark have come to rely much less on concentrates. In Jutland, where Shorthorns and Jerseys run with the Red Danish cattle, there appear to be no differences in the efficiency of roughage conversion. The Danes believe that it takes only one lactation for a cow to become accustomed to a large bulky ration, but this is provided the rumen flora have been adapted to it during the previous dry period. This gives further weight to the need to continue the bulky ration through to the end of lactation. It is possible, too, that selection may help even further.

An interesting example showing how selection has assisted, by giving a flatter lactation curve, comes from Finland. Obviously a cow whose daily yield is never excessively high, but which yields consistently well late into the lactation, is more suited to a roughage feeding scheme. The Board of Agriculture in Finland therefore devised the following standards for cows entering the merit classes in their two herd books for the native Finnish and Ayrshire breeds. For the Elite class, in addition to milk and butterfat qualifications, a cow is only permitted to give 62 per cent of her total lactation yield during the first five months after calving. Excessive length of lactation is guarded against by a limit of 15 months in the calving interval. Similar qualifications are required of the daughters of a bull registering under the equivalent of our R.M. The scheme has given remarkable consistency of yield in many Finnish herds and so helps to eliminate the problem of feeding bulky foods to a cow that rises to a high peak of production early in lactation.

Although in Scandinavia they believe in introducing a roughage ration during the dry period, this is usually taken a step further. Bulky foods are given to replacement stock during rearing to train them to these foods as early as possible. Again, great importance is attached to this aspect of roughage feeding to help acclimatize stock before they enter the herd. How far concentrates can be replaced depends largely on the quality of the fodder. For example, water is frequently offered to calves from birth to encourage them to eat the best quality hay. The hay nets may be changed twice a day at ten days old to start them eating even a few wisps of leaf. In later stages, silage and fodder beet are given, and by 7 or 8 months of age no concentrates

are needed. This may entail some severity for yearlings during the winter, but they more than regain condition when turned out on to grass, provided this is of the same class that we believe is necessary for dairy cows.

Application in Britain There is little doubt that bulky foods could be utilized better in this country by adapting some of the Scandinavian principles, but with the proviso that we should also improve the general run of the quality of our hay and silage to their standards. In Finland, for example, where the small family farm has traditionally thought in terms of self-sufficiency, enough high quality fodder is conserved during a four-month growing season to provide feed for the eight-month winter, in some cases even for cows that yield their own live weight of butter fat in a lactation. If this is possible in Finland, surely in this country we have the opportunity to provide good quality bulky foods to meet the needs of at least a modest level of milk production.

LOUIS PASTEUR

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September 28 this year is the sixtieth anniversary of the death, at the age of nearly 73, of Louis Pasteur—a man who revolutionized scientific thought and conferred many lasting benefits on mankind.

THE full importance of Louis Pasteur's work to agriculture, both directly and indirectly, should never be forgotten. He was a chemist who turned to biology and joined the two sciences together by his discoveries of the importance of those minute forms of life which we know today as bacteria, yeast and primitive fungi. His direct and early achievements for agriculture were in the overcoming of difficulties in certain ancillary industries—in the making of vinegar and wine, and in brewing. Next he conquered the diseases of silkworms and then mastered chicken cholera and the devastating anthrax disease of animals. This is a praiseworthy list, and I give more details below, but it is nothing compared with the indirect benefits which his work produced for farmers. Pasteur introduced and proved the "germ theory of disease," that life only came from life and could not be produced anew spontaneously, that these minute forms of life floating in the air would work for or against man's interests and, moreover, that the harmful forms could be destroyed by certain methods of heating—by what, in fact, has come to be known as "pasteurization". Where would our dairying and other industries be today without the sterilizer and pasteurizer? Both are the outcome of his discoveries.

"There is only Science . . ." Louis Pasteur was the son of a tanner who had been a sergeant in Napoleon's army; he was born in 1822 at Dôle, in the Franche-Comté, the third of five children. He was considered rather slow at school and his ambition was to become an artist. His schoolmaster, however, soon inspired him to greater efforts, and eventually he entered the "École Normale" in Paris, which is the post-graduate college for the training of teachers. Here he studied chemistry and

soon made his first remarkable discovery—that of asymmetry in molecular structure. It was an important one and persisted in the mind of the great man throughout his life because he was convinced it had something to do with the fundamental nature of life itself. The discovery was that certain organic compounds could have different structures, although they had the same chemical composition. The atoms of some compounds could be arranged unsymmetrically, and frequently one arrangement was the mirror image of the other. This, he found, was true of tartaric acid. Moreover, these two forms of the same substance had different physical properties, among them being the power—when in solution—to turn the ray of polarized light either to the left or right as it passed through the solution. Pasteur was able to show that these crystals could be distinguished one from the other by their actual shape. Indeed, if one had sufficiently sharp eyes, it was possible to pick out the left-turn form from the right-turn form with a pair of tweezers. Soon he discovered that certain bacteria would attack one form and not the other, and this led him to the study of the biology of these animaculi. Pasteur had set out to be a philosopher and chemist. He wanted to create a new system, but this he never did because the impact of biology on chemistry led his remarkable mind into other fields. He was always tackling immediate problems and never got back to his study of asymmetry and the creation of his system of philosophy. He became mainly interested in these minute forms of life which were thought by the majority of scientists of the day to arise spontaneously in decaying organic matter, and not to be the actual cause of its decay. After studies on the fermentation of lactic acid and vinegar, his first tremendously important and very controversial work on wines was done. Grape juice, said Pasteur, ferments because the yeast on the skin of the grapes grows, and without yeast juice will not ferment. This was hotly disputed, but Pasteur proved his theory by a series of remarkably clever experiments. He went from success to success. It was not only that he was a brilliant man and tremendous worker, but his fire and energy had a compulsion about them that infected all who came in contact with him.

At the age of 46 he had a paralytic stroke and it was thought that his career was finished. But he overcame this, and his drive and enthusiasm were in no way reduced. Pasteur had a great capacity not only for discovering the scientific fundamentals of a process but also for devising practical methods of making use of his discoveries. In fact he could see no difference between theory and practice. "There is only science" he said, "and the application of science."

Inception of the Germ Theory His next task was a difficult one. He was asked by a friend, J. B. Dumas, to go to Alais in the south of France and study the "pebrine," a disease which was threatening to wipe out the important silkworm industry and so bring ruin to thousands. The silkworms sickened, became covered with small black spots, as if they had been dusted with pepper (hence the name "pebrine") and died. Even bringing in eggs from abroad was no guarantee of immunity. Pasteur knew nothing of silkworms or of the industry, but he approached the problem with enthusiasm and his usual double attack, "science and the application of science". Difficulties and disappointments beset him but in the end he found the remedy. Only healthy eggs must be used for the next generation of silkworms: so the moth was induced to lay eggs on a card, to which the dead female moth was then pinned. Each of these moths was then examined for signs of the disease bacteria by grinding it up with water and examining a drop under the microscope. If the "pebrine" bacteria were found, the eggs on that card were burnt. If they were not found, the

eggs were pronounced healthy. Complaints were made that this was too difficult a thing for the farmer to do. Pasteur replied: "I have an eleven-year-old child in my laboratory who can do it." She could too; it was Marie-Louise, his daughter.

The fact that bacteria could cause disease in silkworms led Pasteur to the "germ theory of disease," that many diseases were caused by bacteria—a concept we know to be true today but which was vigorously denied at the time.

He next triumphed over chicken cholera and anthrax, both of which yearly killed thousands of animals. Finally, he tackled rabies and, in spite of the fact that he could find no causal bacteria (it is in fact a virus disease), he found a cure. The fantastic experiments and the dramatic cures which he effected caused his name to ring round the world, and the Pasteur Institute was started in Paris with contributions sent from very many countries and individuals.

It will be seen that all Pasteur's early work was of direct benefit to farmers —particularly the control of anthrax. This alone is said to have saved France more than the whole indemnity paid to the Germans at the end of the Franco-Prussian War. Even the control of rabies was important on the land, since more country people than townspeople were bitten by mad dogs.

Pasteur was frequently involved in controversies with fellow scientists, the most violent being that on "spontaneous generation" to which I have already referred. The accepted theories of the day were that germs were unimportant—that they were produced anew each time by spontaneous generations as organic matter decayed. Pasteur, in the opposite camp, declared that man cannot produce life, and that it was the germs that produced disease and decay. The more he proved his contention to be right, the more violent the argument became; even a challenge to a duel is recorded! Parenthetically, it is interesting to note that an American scientist has recently claimed to have created life spontaneously!

Pasteur in Britain Pasteur first came to London, with his son, in early September 1871 and stayed at the Grosvenor Hotel, Victoria. He visited Messrs. Whitbreads in Chiswell Street, who purchased a microscope for him. They still preserve it with reverence to this day—a rather fine, well-made binocular instrument. Pasteur greatly astonished the brewers by being able to pronounce on the quality of the beer from a microscopic examination. He was, of course, able to identify souring organisms and exhausted yeast cells, whose role was not even suspected by brewers in those days. His effect on British brewers was tremendous, and his theories on fermentation and spoilage were soon accepted. Soon every brewery had its own laboratory.

Pasteur's next visit to London was in 1881, when he came to attend the International Medical Conference. His comments at this period are interesting. He found a hotel in the Charing Cross area so bad that he took three rooms for himself and his son at No. 8 Half Moon Street, where they paid 4*s*. per day each plus 2*s*. for service. Lunch cost 2*s*. 6*d*. and dinner 4*s*. if ordered beforehand; it appears that he and his son were trying to economize so that they could buy souvenirs for their wives! The confusion at the commencement of the Medical Conference, he said, was tremendous, and one feels it must have been something special if even a Frenchman could describe it as such. The big controversy at this time was still whether germs of disease, fermentation and putrefaction arose spontaneously, or whether they could arise only from other similar germs. At this conference the great

Lister and the germ theory were attacked by Bastian, an English scientist. Pasteur did not speak English and was therefore at a disadvantage, but under cover of the applause he asked Lister what Bastian had said. One sentence from the great surgeon was sufficient. Lister said: "He believes in the spontaneous generation of germs." Pasteur could not "suffer fools gladly". He had no patience with anyone who sought to fly in the face of scientific evidence—*his* evidence, proved by *his* experiments. He got up and in a short speech effectually demolished Bastian.

On this visit he took great pleasure in recording that on August 9, 1881, he visited a splendid dairy (it must have been in or near London) based entirely on his work, where cleanliness reigned and where he wrote in the visitors' book: "The battle against the danger of pathogenic germs being introduced accidentally into milk has been victorious in this establishment". It would be interesting to identify this place. A week later his speech at the Medical Congress had been printed and distributed to all Members of Parliament. His theories were being accepted.

His next visit to Britain was in 1884, to attend the tercentenary celebrations at Edinburgh University, where he and de Lesseps (the builder of the Suez Canal) represented the French Academy of Science. Mr. Younger, of the brewery of the same name in Edinburgh, was a great admirer of Pasteur. He not only provided the railway tickets, but had a special saloon coach put on the train from London to Edinburgh for the greater comfort of Pasteur and his friends. Whilst he was a great success at the ceremonies (the tremendous applause which greeted him when he rose to speak he thought was meant for the Prince of Wales), I like to think of him making a rather amusing speech at the dinner on the previous night. As we are inclined to think of Pasteur as an eminent but dry-as-dust scientist, the story he told is illuminating. It came after a lot of dull oratory and must have been a welcome relief:

> *We have in France a proverb—though I cannot guarantee its accuracy, which says, "Variety is the only thing that pleases people". You have had speeches in English and German. I, for a hundred reasons, will speak in French and tell you a story about Henry IV (of France). After a victory, Henry was travelling through the conquered country when, outside a town, the governor approached him and said: "Sire, we did not fire a salute of guns at your approach for a hundred reasons: firstly, we have no guns . . ."*
>
> *Henry interrupted, "I will excuse you from relating the other ninety-nine," he said.*
>
> *You will please excuse me; my first reason is I do not talk English . . .*

Pasteur then became serious and revealed what is really the key to his character and success. Enthusiasm, he said, was vital. The word came from the Greek *en theos*, meaning an inner god—and this inner god must be cultivated to the full.

The Scotsman printed a special edition in honour of Pasteur, with his speeches in French and English, and Mr. Younger gave £500 to the University in memory of the occasion; Younger's brewery still has a file of his letters.

Rabbit Problem In the last few years the rabbit population of Australia has been decimated by myxomatosis, and in this connection it is interesting to note that in 1888 Pasteur wanted to destroy the rabbits in Australia on similar lines with the chicken cholera disease, and, in fact, sent three of his staff there. The government of New South Wales had offered a prize of £25,000 for a method of ridding the State of rabbits, and Pasteur was particularly incensed that his team (consisting of his nephew, Adrien Loir, Dr. Germont and an Englishman, Dr. Hinds) was never allowed

to make full-scale trials of their rabbit disease, which small tests had shown to be very successful. The team was instead being urged to show the Australian scientists how to make anthrax inoculations. Pasteur wrote to the Agent-General in London with some asperity: "My team was not sent to Australia, at my own expense, to give lessons in microbiology". Had he been there himself no doubt things would have been different. Pasteur, ever the practical man, thought it was that the word "cholera" frightened people too much. If perhaps he had called it "myxomatosis" Australia might have been free from rabbits sixty years earlier.

The Indefatigable Pasteur was a very humble person, a profound thinker and a great patriot; though he formulated the dictum "science has no country," yet he was deeply disturbed by the Franco-Prussian War and returned his decorations to the University of Bonn as a protest at the bombardment of Paris. His idea of revenge was not to stage another war against the Germans, but to make French beer as good as German beer. Would that all our disputes could be settled in this amicable manner! In order to prepare his *bière de revanche*, he applied the principles of fermentation which he had mastered in his study on wine and (the typical Pasteur method) visited the principal breweries of Europe so that he could study their procedure at first hand. Pasteur, the scientist, never despised the practical man. To my mind, had he met the much-maligned Mr. Squeers of Dotheboys Hall, he would not have seen much wrong in the schoolmaster's Socratic touch, "C-L-E-A-N W-I-N-D-E-R, clean window, now go and do it". One of Pasteur's most interesting remarks in discussing his method is: "Nothing must be neglected, and an observation from a rough labourer who does well what he has to do is infinitely precious".

Pasteur would prove a theory to his own satisfaction and then do his utmost to ensure its acceptance by sheer force of his enthusiasm, backed by convincing demonstrations. It is difficult for us today to realize the magnitude of the changes in the rigidly held ideas which he put forward with his germ theory. Dubos has suggested a modern parallel—like trying to convince a telephone engineer of the importance of telepathy as a means of communication. He was an indefatigable worker. *Travaillez, travaillez toujours* he is supposed to have said. I do not think so: Pasteur is far more likely to have said: *Travaillons, travaillons toujours*, for he was not a man to contract out of any obligation.

Some Articles of Outstanding Interest

● **NEXT MONTH** ●

The National Agricultural Advisory Service	*by* CLYDE HIGGS
Crops not Rabbits	*by* A. G. ARMITAGE and R. E. ROGERS
The Story of F.A.O.	*by* SIR DONALD VANDEPEER
Diagnosis of Pregnancy in Farm Animals	*by* P. G. MILLAR

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WINTER WHEATS RECOMMENDED BY N.I.A.B.

WINTER WHEATS RECOMMENDED BY N.I.A.B.

CHARACTERS SUMMARIZED IN TABULAR FORM

Note. *High figures indicate high merit. Early ripening and short straw are considered desirable for the purpose of the table, but may not always be so.*

Varieties are given, in each section, in order of probable yields under average conditions in standing and disease-free crops.	General List									Varieties of Very Limited Use		Varieties Provisionally Recommended				
	Hybrid 46	Bersee	Staring	Juliana†	Victor†	Redman	Holdfast	Yeoman	Square-head's Master (13/4)	Rampton Rivet†	Little Joss†	Cappelle Desprez	Minister	King II	Pilot*	Masterpiece
Agricultural Characters:																
Standing power	9	7½	8	7	6	7½	8½	7½	6	6	3	8½	8½	8	7	6½
Shortness of straw	8½	6	6	5½	5	6	7	5	4½	2	3	9	8	6½	5	4½
Resistance to sprouting ..	5	5	3	3	3	5	2	5	5	9	5	5	3	5	5	5
Resistance to yellow rust ..	9	8	9	8	7	8	6	8	7	9	8½	5	9	6	4	6½
Resistance to loose smut ..	2	6	7	5	7	7	7	7	7	9	5	9	7	9	6	5
Resistance to mildew ..	7	8	6	6½	6	6½	7½	7½	7	8	7	7	6	6½	6½	7½
Earliness of ripening	8	9	4	4	4	5	7½	6	5	2	5	8	8	3½	4	5
Suitability for late sowing (February)	7	9	5	5	5	7	7	7	7	5	6	7	7	2	3	7
Quality of Grain:																
Milling quality	4	4	6	6	6	8	8	8	6	5	6	4	5	3	7	8
Bread-making quality ..	5	5	5	5	5	7	9	6	3	4	3	6	5	5	4	7
Varieties of known good biscuit-making quality ..	–	–	x	x	x	–	–	–	x	–	x	–	§	–	–	–
Date of First Recommendation	1950	1942	1950	1936	1930	1944	1936	1930	1930	1939	1930	1953	1954	1952	1950	1954

Comments on the more important features of each variety and recommendations for use are made in the notes on the individual varieties.
Varieties provisionally recommended are still undergoing further trials.
† To be removed from the list in January 1957. * To be removed from the list in January 1956. § Shows some promise for biscuit-making.
Reproduced from Farmers' Leaflet No. 8 with permission of the National Institute of Agricultural Botany.

THE MINISTRY'S PUBLICATIONS

Since the date of the list printed in the July 1955 issue of AGRICULTURE (p. 188), the undermentioned publications have been issued.

MAJOR PUBLICATIONS *Copies are obtainable at the prices quoted from the Sale Offices of H.M. Stationery Office or through any bookseller.*

Bulletins

No. 34 Mushroom Growing (*Revised November 1954*) 5s. (5s. 2d. by post)
No. 69 Onions and Related Crops (*Revised February 1955*) 2s. (2s. 1½d. by post)
No. 95 Strawberries (*Revised May 1955*) 2s. 6d. (2s. 7½d. by post)
No. 123 Diseases of Vegetables (*Revised August 1954*) 4s. (4s. 2d. by post)
No. 132 Cabbages, Brussels Sprouts and Miscellaneous Green Crops (*Revised March 1955*) 2s. (2s. 1½d. by post)

Other Publications

Farm Book-keeping (*Revised April 1955*) 1s. (1s. 1½d. by post)
The ABC of Preserving (*Revised April 1955*) 1s. 6d. (1s. 7½ by post)
Toxic Chemicals in Agriculture: Risks to Wild Life (*New*) 1s. 6d. (1s. 7½d. by post)

LEAFLETS *Up to six single copies of Advisory and Animal Health Leaflets may be obtained free on application to the Ministry (Publications), St. Andrew's Place, London, N.W.1. Copies beyond this limit must be purchased from the Sales Offices of H.M. Stationery Office, price* 2d. *each* (3½d. *by post*).

Advisory Leaflets

No. 104 Pig Feeding (*Revised June 1955*)
No. 151 Parsnips (*Revised July 1955*)
No. 224 Red Spider Mite on Glasshouse Crops (*Revised June 1955*)
No. 292 Pink Rot and Watery Wound Rot of Potatoes (*Revised July 1955*)
No. 416 Farm Dairy Hygiene (*Revised July 1955*)
No. 427 Feeding Turkeys (*New*)
No. 444 Magnesian Lime and Magnesian Limestone (*New*)
No. 445 The Smith Hive (*New*)

Animal Health Leaflets

No. 10 White Scour in Calves (*Revised June 1955*)
No. 13 Salmonellosis (*Revised April 1955*)
No. 33 Bovine Contagious Abortion (*Revised July 1955*)
No. 46 Fowl Cholera (*New*)
No. 47 Lice Infestation and Mange of Cattle (*New*)

FREE ISSUES *Obtainable only from the Ministry (Publications), St. Andrew's Place, London, N.W.1.*

Farm Machinery Leaflets

No. 16 Green Crop Collectors and Loaders (*New*)
No. 18 Tripods and Racks for Haymaking (*New*)

Farming Topics

No. 11 Pig Recording Pays (*New*)

Growmore Leaflets

No. 26 Storing Vegetables in Winter from Allotment and Garden (*Revised July 1955*)
No. 111 The Use of Lime in Horticulture (*New*)

Miscellaneous Booklets and Leaflets

At the Farmer's Service (*Revised March 1955*)
Full-time Agricultural Education in England and Wales, 1955-56 (*Revised June 1955*)
At a Glance: Grants, Subsidies and Services for Farmers and Landowners in England and Wales (*Revised April 1955*)
Take Care when you Spray (*Revised June 1955*)

FARMING AFFAIRS

Cutting Costs in Milk Production Economy in the costs of milk production has been well demonstrated at Steeton House, a 200-acre farm (73 cereals, 96 grass, 18 lucerne, 13 kale) in the W. Riding. Expensive concentrates have been replaced by high quality food produced cheaply on the farm and labour costs have been reduced. The herd at Steeton House is Friesian, T.T., consisting of 31 cows and heifers in milk, 3 cows and 6 heifers in calf, and 42 other stock, and is in the process of being graded up to pedigree status; all calves are dehorned, and most of the replacements are home-bred. Steers and surplus heifer calves are sent to an adjoining farm for finishing on grass as beef at 2½ years old.

The feeding changes, introduced by the farmer, Mr. E. R. Pears, and which last year produced higher yields than in any previous year, were as follows:

Average Amount of Feed per Cow

Food	1947-48			1953-54		
	Winter *cwt.*	Summer *cwt.*	Year *cwt.*	Winter *cwt.*	Summer *cwt.*	Year *cwt.*
Concentrates:						
Bought	11.2	4.3	15.3	7.0	4.4	11.3
Home-grown	11.9	0.5	12.1	2.8	1.2	3.8
Hay	8.9	0.9	9.6	7.0	4.4	11.3
Silage	—	—	—	69.0	2.9	69.0
Kale	24.1	11.3	35.1	27.2	—	25.0
Mangolds	47.4	—	47.4	2.4	0.4	2.7
Sugar beet tops	33.7	—	33.7	34.1	—	31.3
Wet brewers' grains	—	—	—	21.0	21.4	42.4
Concentrates fed per gal. (*lb.*)	7.9	1.2	3.9	1.9	1.5	1.7

The summer ration, for maintenance and 5 gallons, comes from grazing on three-year leys, plus a little wet brewers' grains. The basic winter ration, for maintenance and the first 4 gallons, is:

	lb.	*s.*	*d.*
Hay	10		5
Silage	45	1	4
Kale	80		10
Wet brewers' grains	25		6
Crushed oats and flax chaff	3½		5
		3	6

Concentrates are fed at the rate of 3½ lb. for every additional gallon.

The main aim is a continuous supply of cheap crops strip-grazed with an electric fence. Heavily manured kale provides grazing from December to March, when it is supplemented by early bite on Italian ryegrass (normally undersown in spring wheat and left down for two years). From April until late summer the herd is mostly on timothy—meadow fescue—white clover leys, while lucerne—cocksfoot seeds mixtures, after producing two or more heavy silage cuts, give aftermath grazing for September and into October. Italian ryegrass and some early foggage take the stock up to the end of November. All the leys receive fairly heavy dressings of compound fertilizers and "Nitro-Chalk" throughout the year.

Hay is cut early from the three-year leys and pick-up baled in the field, thus saving labour. Silage from the cocksfoot—lucerne leys is an important

feature. Last year silage-making began in mid-May and the first two cuts from 18 acres produced over 150 tons with a crude protein content of about 22 per cent of the dry matter.

Mr. Pears insists on cows with an inherited capacity to milk and a hearty appetite, so that they waste no time eating their ration and quickly let down their milk as they come into the milking parlour. Both winter and summer the cows have to walk a mile to and from the fields to eat the bulk of the daily ration. They seem to have a capacity to consume bulk and are very fit. The condition of their feet and legs—a major concern for modern dairy farmers aiming at high yields—is particularly good.

In output, costs and profits, the figures below speak for themselves:

	Costed Milk Farms in Yorkshire	Steeton House	
	1951-52	1951-52	1953-54
Average yield per cow (*gall.*)	727	857	977
Percentage winter milk	48	47	52
Total concentrates per cow (*cwt.*)	19.3	22.6	15.1
Cost of all concentrates per cow (£) ...	25.9	14.4	13.2
Labour hours per cow	131	115	93
Labour hours per 100 gallons	18	13¼	9¼
Average returns per gallon (*d.*)	36¼	37¼	39¼
Net cost per gallon (*d.*)	24¼	17¼	19¼
Profit per gallon (*d.*)	12	20	20
Profit per cow (£)	36.4	71.1	80.9
Profit per acre (£)	15.2	34.5	36.8

The standard of management on this farm is demonstrably very high, producing more than twice the profit, whether measured per cow or per acre, of the average Yorkshire milk farms costed by Leeds University.

The writer acknowledges the valuable assistance of Mr. Wynne, of the Department of Agricultural Economics, University of Leeds, in the preparation of this article.

G. D. Pick,
District Advisory Officer

Farm and Forest: 6. Thinning Woodlands

As with agricultural crops, the proper care and maintenance of a tree crop are essential if the owner of woodlands—whether they be of a few acres or a thousand acres—is to get the full benefit from the land and from the money put into it in the form of trees, material (such as fencing), and labour. In a newly-planted area the number of trees per acre may range between 1,200 and 3,000, but the average is probably about 1,750, which is equal to a spacing between trees of five feet. In the early stages this closeness of spacing is necessary for most tree crops if they are to develop satisfactorily and eventually produce millable timber of reasonable cleanness, straightness and quality. Thinning out a tree crop at regular intervals is one of the main jobs from the time a plantation reaches a height of 20-25 feet until the crop is ripe for clear cutting. Advantage is taken in each thinning to remove any sickly and badly-shaped trees, as well as to cut out those which may be interfering with the development and growth of the better stems. A fairly usual thinning interval is five years, and as a rough guide a wood should be thinned when the trees have put on ten feet since the previous treatment.

Before making a thinning, it is advisable to know what use can be made of the trees to come out. The answer may be relatively simple if they are of a type and size suitable for fencing stakes and posts. On the other hand,

there may be no obvious outlet, and in such cases it is wise to seek advice before going ahead. Beware of "skinning" woods, whether they are large or small, by taking out the odd tree for a job on the farm; it is usually one of the best trees that is chosen, and persistent skinning results in a semi-derelict crop and loss of production from potentially valuable land.

So far as advice is concerned, there may be a local forester handy. If not, the local Forest Officer of the Forestry Commission will be able to help, or a note to the nearest Commission office will put the farmer in touch with a source of advice. A grant of £3 15*s.* per acre is available from the Commission for early thinnings in blocks of not less than two acres.

As was suggested in the first article in this series (April 1955), forestry has only recently come to the fore as an important industry in this country. It is well to remember that a substantial part of the pitprops and pulpwood imported from Scandinavia and Finland is cut by farmers each winter from their own wood lots. Farmers in those countries, and in parts of North America too, look on their woods as an integral part of the farm economy.

A. Watt,
Conservator, Forestry Commission

The Mechanic on the Farm: 17. Putting the Mower Away It is better to repair implements and machinery immediately after their season of use rather than just before it, because then there is plenty of time to do the work without hurry and get any spare parts that may be needed. An hour or so spent regularly in the farm workshop each day is a great help towards steady, all-the-year round work on overhauling the farm equipment; and now that there are so many satisfactory rust preventers, an overhauled machine can safely be left in store ready for when it is required.

The mower should certainly be overhauled before it is put away for the winter. First of all, the pitman-to-crankshaft angle should be checked by a straight edge. If the pitman does not lie at right angles to the crankshaft it should be made to do so by adjusting the brace bar or yoke bar. Next, the lie of the knife in relation to the pitman should be checked by stretching a string from the centre of the bearing at the fly-wheel end of the pitman to the far end of the cutter-bar. The far end of the knife should be slightly in front of the line of the string when the cutter-bar is being held pressed back to take up any play caused by wear. The distances between the string and the rear edge of the knife at both ends of the bar should be measured. There ought to be a lead of ¼ inch for every foot of cut of the knife, so that the cutter-bar runs square when the mower is under load. Adjusting the length of the stays or draglink will correct the lead, but sometimes the shackle bolts will have worn so much that they ought to be renewed.

Finger liners must be level so that the knife sections can lie flat on them. Levelling can be done by sighting, and fingers which are out of line can be knocked up or down with a hammer. The cutting edge of the finger gets rounded with wear, and it may be found that the liner or even the whole finger needs replacing. If, however, wear is only slight, the side of the finger, or finger liner, can be ground to a sharp edge. The knife should be checked for play where it passes under the clips. Clips are usually malleable and can be tapped down if there is too much up-and-down movement. If there is excessive fore-and-aft play the wearing plates should be moved forward to compensate for it.

Knife register should be examined by trying the pitman at the extreme inner or outer end of its stroke. In most makes of mower every section of

the knife should centre on a finger in either of these positions. If the register is incorrect look for the cause; it may be a bent adjusting brace or excessive wear in the pitman or other bearings.

The knife (and the spare knife if there is one) should have all its sections sharpened, and new sections should be fitted where necessary. Then the knife, cutter-bar and all other work-polished parts of the mower should be covered with a rust-preventing compound and the machine put away. The knives are best stored separately in wood sheaths. Wheeled mowers should be jacked up off the floor; mounted mowers should be stored with all clamp bolts left in place so that they shall not get lost. Any driving belts should be loosened.

H. J. Hine

A Million Acres of Woodland Yet another milestone in Britain's post-war expansion has been reached with the announcement by the Forestry Commission that this year their forest area will reach one million acres. Since 1947 the figure for annual plantings has increased steadily, on average by 6,300 acres a year, until in 1954 a total of 70,437 acres was achieved.

But there is a dark cloud on the horizon of the Commissioners' future programme, for this yearly increase has been maintained only by materially reducing the reserves of land awaiting planting proportionate to the area actually planted. In 1947 the reserve stood at 13.6 times the annual planting programme: the figure for 1955 is only 4.6 times, and the reserve is not all evenly distributed. Thus, says the Annual Report of the Forestry Commission,* the point has been reached where the Commissioners have been forced to accept the unpalatable fact that after 1954 the annual planting will fall.

The trend of private planting goes on steadily. At an estimated 19,100 acres in 1954, this was 900 acres more than in the previous year. And there should be no falling off in the future, particularly as the obligation to replant, which has been a condition attached to most felling licences issued since 1951, begins to be implemented. Progress continues to be made also under the Dedication of Woodlands Scheme, and during 1954 the area dedicated increased by 116,667 acres to 342,621 acres. By the end of September 1954, the number of estates in the Approved Woodlands Scheme (woodlands which, although not dedicated or eligible for Small Woods Planting Grants, are managed in accordance with a plan approved by the Commission) was 146, covering 44,400 acres.

Since its formation the Commission has acquired over 2 million acres in Britain (including rough grazings, agricultural land and areas unsuitable for afforestation) and today is administering nearly 500 forests. But, if a return is to be made to the upward trend in planting, suitable land must be acquired much faster than hitherto. There are large tracts in this country, running into many hundreds of thousands of acres, the best use of which is undoubtedly forestry—including land densely infested with bracken and semi-derelict woodland. It is sincerely to be hoped that this type of land will be more readily offered to the Commissioners by those owners who are unable to plant it themselves.

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* *35th Annual Report of the Forestry Commissioners* (year ended September 30, 1954). From H.M. Stationery Office, or through any bookseller, price 3*s.* 6*d.*

IN BRIEF

Electricity on South Wales Farms

Last year, the South Wales Electricity Board added 1,311 farms to its system, thus bringing the total to 6,768 farms. By the end of March 1956, the year's figure should have reached 2,000. There are roughly 25,000 farms in South Wales, and of these some 3,500 are so inaccessible that it is unlikely that they will ever be supplied with electricity. Of the remainder, 14,000 have still to be connected, and at the rate of working this year, it is hoped that they can be completed in less than eleven years. These facts were given by Mr. W. A. Gallon, Deputy Chairman of the South Wales Electricity Board, at the Royal Welsh Show, Haverfordwest.

The Board spends about £5 million a year on capital expenditure and about £1¼ million on rural development extension. The rate of electricity consumption on farms has shown a slight increase recently, but much greater use can and should be made of the supply if the undertaking is to be economic.

Londonderry Ley

Fifty acres of grazing on a 98 acre farm in Londonderry last year finished 54 out of 74 fattening cattle, besides supporting 15 stores, 1 cow, 6 calves, 37 ewes, 56 lambs and 1 horse. The pasture strains are well blended, comprising several kinds of ryegrass, cocksfoot, timothy, meadow grass and red and white clovers. Italian ryegrass has proved itself highly productive and especially valuable for late autumn and early spring grazing for sheep. The fattening cattle on this farm have been making an average liveweight gain of ¾ cwt. a month during the grazing season. The farmer is Mr. R. A. Eaton, of Benvista, Derrychrier, and his manuring programme, in addition to liming, provides for 4 cwt. of a mixture of 1 part sulphate of ammonia, 4 parts superphosphate and 1 part muriate of potash per acre at the time of sowing down. Established pastures are dressed with a mixture of 4 cwt. superphosphate and 1-2 cwt. muriate of potash per acre in February every year. The medium-sized fields are grazed in strict rotation (all have a piped water supply laid on), and topped when necessary to avoid flowering and to keep the weeds in check.

Grass for the winter is conserved in the form of trench silage and tripod hay. Last season, 24 tons of high quality tripod hay were made from 12 acres, the young swards reserved for the purpose being dressed with a mixture of 4 cwt. superphosphate and 2 cwt. muriate of potash per acre in February, and 2 cwt. sulphate of ammonia per acre in May. Cutting usually starts in early June, and the aim is to have all the hay saved by the middle of July.

Digest from the Northern Ireland Monthly Agricultural Report

Grey Squirrel Bag

In the past two years of intensified campaigning, 753,527 grey squirrels were killed in Gt. Britain—725,072, in England, 22,167 in Wales, and 6,288 in Scotland. Of these, the "bob-a-tail" was claimed in respect of 590,653—the cost £29,533. In many instances free cartridges were claimed by Squirrel Clubs instead of the shilling. With the coming of autumn, the guns should be out again; in the meanwhile widespread trapping is being urged.

Self-Service Silage

The feeding of silage is a problem. Quality and weight of different parcels from the same silo usually vary greatly. Weighing is worth while for the best material, but whatever method of service is used the cost of distribution is high in proportion to the food value. There are trials in self-service, letting cows help themselves from the face of a stack, consumption being regulated by rails or yokes which are moved forward as the silage is eaten. The stack must be on a firm bottom, concrete for preference. Nine inches of feeding face per cow per day is sufficient with twenty-four hours' access. On this basis, a cow will eat over 1 cwt. daily. In one herd where this method has been practised for three years there has been trouble with hypomagnesaemia, possibly as a result of high production from leys. The preventive for this modern disease has yet to be found. Self-service silage means that cows are getting about twice as much as they need; it is for individual farmers to decide whether labour or food is cheaper.

Judging by the number of tumuli of many shapes and sizes to be seen as one travels the countryside, there is a revival of interest in ensilage. Later that pungent aroma will pervade many a cowshed and disturb many a housewife when her husband returns from work.

Clyde Higgs, Times Agricultural Review

Toxic Chemicals and Wild Life

Points about the risk of toxic chemicals to wild life made by the Zuckerman Working Party in their report include:

The sprays most likely to be harmful to wild birds and mammals, in order of danger, are organo-phosphorus insecticides applied to brassicas in late summer; arsenical compounds used for potato haulm destruction in September; dinitro weed-killers applied to corn and peas in spring and July; and DDT insecticides applied to orchards, carrots and peas.

Dinitro weed-killers, such as DNC and dinoseb, if used with proper care and as early as possible in the season, will not cause heavy casualties among birds and mammals.

Hormone weed-killers, which are of low toxicity, require no special precautions to ensure the safety of birds. In certain circumstances, however, farm livestock may be in danger, since poisonous plants such as ragwort may, for a period, becoming very appetizing.

Arsenical sprays, although very toxic to birds and mammals, do not cause casualties when used on fruit trees; when used to kill potato haulm, special care should be taken to see that fences and gates are secure, so as to prevent farm stock straying into treated fields, and to see that spray liquid is not spilled in fields other than that being treated.

In windy conditions, covers should be used over spray booms to minimize spray drift. This applies particularly to the spraying of hormone weed-killers and to spraying by contractors, who cannot wait for good weather conditions to the same extent as can farmers.

The danger to insects is probably much greater than that to birds and mammals and, at the same time, more difficult to evaluate or even to discover.

The report costs 1*s*. 6*d*. from H.M. Stationery Office or a bookseller.

Forest of Dean

A Committee under the chairmanship of Sir Thomas Creed, K.B.E., M.C., Q.C., has been appointed by the Forestry Commissioners to review the situation in the Forest of Dean and, having regard to all existing rights and interests, to recommend such measures as they consider desirable and necessary to secure that the administration of the Forest, more particularly as regards the grazing of animals, may be adjusted to modern requirements.

Most of the Forest of Dean is Crown property, but the Free Miners (persons living in the hundred and working a year and a day in the mines there) retain most of the privileges, which are regulated by a Verderer's Court.

The Wryneck Mystery

What has happened to the wryneck? For years past this once common summer visitor has been getting steadily scarcer here, and last year less than a dozen pairs were known to have bred in the whole country. The last breeding pair recorded in Devon, so far as I can trace, was that which I found in 1948. This pair reared their young in a hole in an old apple tree within a mile of my home. I saw no more of the species until spring this year, when a single bird turned up in the same locality, stayed four days and thereafter was seen no more.

A near relative of the woodpeckers, and taking much the same kind of food, the wryneck is a smallish bird, in size between a blackbird and a sparrow, prettily mottled and streaked with grey and brown. Like the woodpeckers too, it has a habit of clinging to the bark of a tree, sometimes using its tail as a support.

In British bird history there have been many examples of numerical decline, sometimes followed by recovery but sometimes, alas, by extinction. In some instances the cause of decline is known and in others it can be conjectured; but there seems to be no apparent solution to the wryneck mystery. It may be that this bird will some day reach its former numbers. All bird-lovers will hope so, for it is an attractive and interesting bird which we can ill afford to lose.

F. H. Lancum

New Farming Plan for Australia

In a further attempt to improve her balance of payments, the Australian Government has announced a new campaign to increase the Dominion's production of primary materials, whilst reducing costs to more competitive levels. The five-year plan adopted in 1952 was designed to increase production in the rural export industries by 24 per cent over pre-war levels by 1957-58. The "sights" have now been raised to make the increase 27 per cent. Wool, beef, veal, sugar, barley and cheese available for export are estimated to be already above the targets set for 1957.

A decade of good seasons over most of the continent and the great reduction in the rabbit population by the spread of myxomatosis have contributed to the expansion of farming and grazing production. Other important factors have been closer settlement and mechanization, helped by imports of farm machinery with dollar loans.

BOOK REVIEWS

The Pruning of Fruit Trees. PAUL CHAMPAGNAT (Edited and translated from the French by N. B. BAGENAL). Crosby Lockwood. 12*s.* 6*d.*

The 166 pages of this book are split into ten chapters, of which the first deals with the life history of the fruit tree and its component members, and the second with general principles of pruning. These chapters can be commended to the student. Practices such as pruning for shape, pruning for fruit, pinching, summer pruning, bark-ringing and arching are all discussed. The practice of "dehorning", as described, is presumably what we term branch thinning in this country. But surely there is something wrong with the statement that root hairs are concentrated "at intervals of about half an inch" on the rootlets!

The main part of the book, however, deals with artificial round tree forms, espalier, simple and compound cordon, and palmette, and the two chapters which follow, on "Pruning for Fruit" under short-spur, long-spur and Lorette methods, are confined to these artificial forms.

Chapters 3 and 4, dealing respectively with French and American methods of shaping natural tree forms, open-centre, pyramid and delayed open centre, are meagre (only 23 pages) and not clear. Such trees, it is claimed, need "have no special pruning for fruiting".

It would appear that French conditions permit much harder pruning than we normally practise in Britain. For instance, the oblique maiden cordon, unless vigorous and pliable, is cut down to 12 inches the year after planting—though it is only fair to point out that weak varieties on dwarfing stocks are advised for simple cordons.

The book is copiously illustrated with line drawings and can be recommended to the student and to those interested in restricted artificial tree forms, but commercial growers will search in vain for the pruning method which is simple to practise and to teach, and which the translator's introductory note says the world is looking for.

W.G.K.

A Review of Productivity in Farming. British Productivity Council. 1*s.* 9*d.*

Labour is the most costly resource in nearly every system of farming and its efficient utilization is therefore an important factor in determining farm profits. This is the justification for *A Review of Productivity in Farming*, the twenty-first in a series surveying developments in those industries which sent productivity teams to the United States.

Productivity measures the ratio between production and the labour involved in production. By the end of 1953 production was 55 per cent up on 1939, and productivity had risen by between 47 and 50 per cent. (The authority for these figures is not given. That for productivity is higher than those of H. T. Williams quoted elsewhere in this publication.) No manufacturing industry had so big an increase. The factors responsible for it mostly come under some aspect of farm management, and the importance of such labour-saving projects as direct labour simplification, reorganization of buildings and equipment, ironing out of labour peaks and everything else that will improve the output of labour, is emphasized. It is less easy, however, to follow the reasoning behind the advice to reduce "inputs (particularly purchased feedingstuffs)", however necessary this may sometimes be in order to increase profits.

Impressive examples show the way in which time may be saved by applying the lessons of work simplification. But in this country the increase in output has been due to mechanization more than to anything else, expenditure by farmers on machinery in 1950 having increased by 900 per cent compared with before the war. More electricity, better buildings, and more scientific grassland management have all had their effect.

What it boils down to is that high labour productivity is generally the result of enlightened farming, and this leads the review to conclude that the future will depend on the training and education of farmers. Formally, this will take place within the walls of the universities, agricultural colleges and farm institutes, but it must not be forgotten what an opportunity is also presented here to the district officers and all others associated with them in farm advisory work.

The Review is obtainable from the British Productivity Council, 21 Tothill Street, London, S.W.1.

W.H.L.

A Handbook of British Flowering Plants. A. MELDERIS and E. B. BANGERTER. Ward Lock. 63*s*.

Yet another book is added to the quite considerable number catering for those who wish to identify the wild flowers of the British Isles. It has several attractive and useful features. There are a large number of monochrome text drawings, some of which are quite good, though some of the colours in the twenty-four coloured plates are not so satisfactory. The simple artificial key to the families should be of help to the beginner, but it is debatable whether a careful consideration of all family characters might not lead to more satisfactory methods of determination and to fuller knowledge.

It is not an uncommon fault with books of this nature that they give an incomplete survey of the British flora, even from the systematic viewpoint alone. This criticism must be levelled here: many interesting species are not described or even mentioned. Thus only three species of *Saxifraga* are considered. Treatment of the species recorded varies greatly. There are some quite adequate descriptions but many can only be described as meagre. Within any one work, descriptions should be made comparative. The descriptions in such genera as *Cerastium* and *Trifolium* illustrate the inequality of treatment of species. The absence of descriptions to genera and of keys to both genera and species must reduce the general usefulness of this work. Something seems to have gone wrong with the statements concerning *Centaurea* spp., since the phrase under *C. jacea* "Flower-heads apparently almost radiant" is without meaning; also *C. nigra* has most often capitula without ray florets and the bracts are not green. The figure A of *Silene cucubalus* (better *S. vulgaris*) on p. 73 is not a capsule but a calyx.

W.B.T.

Milk Without Tears. FRANCES DONALDSON. Faber. 16*s*.

Mrs. Donaldson says of her book that it ran away with her. It is not so much the book as her enthusiasm, her ardent zeal to reconcile theory and practice, her sense of mission to help the novice avoid the difficulties and mistakes which she herself has experienced which have stampeded her. The intention is very praiseworthy, but she might more advisedly have gone about it differently. In the event she tilts at a coterie of dairy farming technicians with the same abandon as she attacks established practices. She is condescending towards the average dairy farmer who, while his methods may not have the author's endorsement, is nevertheless not doing so badly if official figures mean anything—an 80 per cent increase and a vastly superior product in twenty years. She suggests that there would be no personal advantage to farmers from a general improvement in the standard of dairy cows because the price of milk would be dropped to meet the new efficiency—truly an astonishing point of view when we know that our very future depends on lower prices and increased sales! She asserts that a flying herd is better than a self-contained one, and relies on outside figures as a basis for her argument. I am intrigued to know, too, why if, as Mrs. Donaldson states, "it is a mistake for anyone starting out to make a living from dairy farming to choose a herd other than the Friesian," she keeps Ayrshires. Dehorned animals have her approval (and here I am in complete agreement). Maybe she hopes, with me, for all naturally hornless breeds, excepting the Highland.

There is much in this book from which the newcomer can learn, but as a whole it fails by its impetuousness. The novice cannot be expected to be able to distinguish between the two, and for that reason the book is unlikely to enjoy unreserved commendation. Certainly it is better to profit by another's experience, but as long as there is dairy farming there will also be toil, sweat—and tears.

C.H.

Statistical Appendix to The State of British Agriculture, 1953-54. K. E. HUNT. Institute for Research in Agricultural Economics, University of Oxford. 10*s*.

In the words of the Introduction, "this is a plain, straightforward collection of statistics about the British agricultural industry". It is a companion to an earlier volume, covering much the same ground, which consisted entirely of charts and diagrams. Although the statistics relate to a shorter period than the charts, figures are usually provided for a pre-war average, a wartime year, the first year of the agricultural expansion programme, and for the last four or five available years.

Most of the material is available in published form elsewhere (it draws to a large extent on Ministry of Agriculture and other official sources), but as it is scattered through a considerable number of publications, this compendium is a very convenient source of reference.

The agricultural industry is now exceedingly well documented, and this volume provides a well annotated and intelligent guide. Sources are invariably quoted, facilitating reference to the original data, and in many instances spaces are provided for manuscript additions in respect of later years.

W.K.P.

Crop Protection. G. J. Rose. Leonard Hill. 30*s*.

This book is a very general causerie on crop protection chemicals and equipment. It is not addressed specifically to farmers and advisers in this country, and it suffers from perhaps too wide an aim. There is, for example, an evident desire to cover overseas markets for our machines and materials.

Undoubtedly, the author's interests really lie in machinery, and the 70 or so pages devoted to this subject do indeed give a very useful account of the various machines available. The rest of the book, however, is uneven. Fungicides are dealt with very briefly in a matter of 13 pages, insecticides more generously in 27 pages, while weed-killers and rodenticides receive slight attention. It also suffers from the fact that chemicals are dealt with both scantily and on a world-wide basis. Thus nitro-paraffins, which are not used in this country, receive a whole page, while schradan is dismissed in half a page, including some rather meagre and unsatisfactory details on how to treat a case of poisoning.

At the end there is a summary of control measures, based on crops and pests. These recommendations are highly misleading, advocating chemicals which are not used in this country, and the control of pests which have yet to occur here. At the same time, such important British pests as Carrot fly and Celery fly are not mentioned. On weeds in barley, the author advocates spraying with DNC to control annual sow-thistle. In actual fact, the British Weed Control Council stated specifically last year that annual sowthistle is moderately resistant to DNC, but is moderately susceptible to MCPA. No mention is made of the use of DNC against cleavers and poppy.

The book is generally attractive, pleasantly illustrated, and includes a number of coloured plates. Unfortunately, the text under these illustrations leaves much to be desired. Thus typical Sawfly damage is stated to be the work of moth larvae feeding, while in connection with a coloured photograph showing a larva of the pea moth feeding, we are told that this insect lays eggs inside the pod of the pea and can, therefore, be controlled in the adult stage or by using systemic poison, provided the application can be made long enough before harvest. Such statements are not only dangerous but inaccurate.

Some attention is devoted to tropical crops, including cotton, coffee and tea, but they are presented so haphazardly as to be virtually useless. The stress on tropical crops is certainly insufficient to warrant the agriculturist in the tropics buying the book.

de B.A.

Flaying and Curing of Hides and Skins as a Rural Industry. F.A.O. Development Paper No. 49. 7*s*. 6*d*.

This publication by F.A.O. treats the problem of flaying and curing from the aspect of lack of knowledge in under-developed countries, mainly under tropical conditions. It is abundantly illustrated and provides adequate guidance for those whose responsibility it is to assist development of agriculture in the various "backward" areas. It describes methods and processes, also the tools and implements required for slaughtering operations under conditions which range from the extremely primitive to the fairly modern. A section is devoted to the troubles which affect animals and their hides or skins previous to slaughter, and a list is given of nineteen insects (including the warble), the diseases, and the mechanical sources (horns, barbed wire, etc.) which can cause damage. Remembering that the three main troubles from which we suffer in Britain (warbles, horns and barbed wire) damage around 75 per cent of cattle hides, we can at least be thankful that our list is not greater.

A good deal of attention is given to the care of hides or skins after flaying, particularly as to curing by drying in districts where salt for preservation is not easily available. In this direction the British Colonial Products Advisory Bureau has issued valuable guidance, based on research and experience of various methods over a number of years.

The section dealing with slaughtering might be improved in a few particulars with advice from practical men connected with that trade, but, in general, the publication ought to prove of great use to those who are acting as leaders in agricultural science in undeveloped areas. The leather industry throughout the world is overstocked with damaged hides and skins, and if it is to hold its own in competition with substitute materials an improvement of its raw material is essential. The F.A.O. publication should assist materially towards that end.

The publication is obtainable in Great Britain from any sale office of H.M. Stationery Office.

W.G.M.

The Cotswolds (Regional Books Series). EDITH BRILL. Robert Hale. 18*s*.

Anyone who writes about the hills must inevitably compete against the standard set by Hilaire Belloc in his book on the Pyrenees. The reason that was a masterpiece is not only that Hilaire Belloc was a master, but also because he had himself trodden with his own feet every yard of the way which he described and because he saw with an original eye and loved what he saw. Miss Brill's book is good because she, too, has tramped the ways she writes of, often and in all weathers, and because she also sees originally and loves her subject.

She begins by telling us about the early history of the hills, of the long-barrows of four thousand years ago and of the Iron Age remains, indicating where the best examples of each are to be found. This is followed by a summary of what is known about the Roman remains and their location. Then she takes us on a series of walks and discusses what is to be seen on the way, speaking now as naturalist, now as historian, now as topographer, and sometimes as plain story-teller.

The book does not pretend to be comprehensive, and there are many fine churches and beautiful country houses which each reader can find for himself and make his own diversion to visit. But if he walks with Miss Brill he will not be bored; he will see many things he may miss on his own, will go where rare flowers grow which he would never have found alone, and will be conscious all the time of the sweep of the land and the wonderful breadth of the sky, which always seem wider over the Cotswolds than anywhere else. Miss Brill knows that to understand hills you must know their streams. She traces the Windrush and the Coln from their sources to the Thames. Finally, there is an excellent map, which should prove most useful to the visitor should he, by intent or ill-fortune, leave the paths followed by the author.

This book will enliven their environment for those who live on or near the Cotswolds and will add to the pleasure of those who visit there.

J.D.

The John Innes High Rate Soil Steriliser (John Innes Leaflet No. 13). Oliver and Boyd. 1*s*.

Until the issue of this leaflet, the only type of John Innes soil sterilizer to have been described in this series was the small boilerless sterilizer, heated by a fire underneath to produce steam at atmospheric pressure. This is now aptly renamed "the John Innes Low Rate Steam Steriliser".

This new leaflet describes the construction and operation of the now familiar John Innes design of floor bin sterilizer, with a steam grid countersunk in the floor of the bin and operated by steam under pressure from a boiler. It is, of course, capable of steaming relatively large quantities of soil for compost-making: a two-bin unit (1 cubic yard each) has a possible daily output of 16 cubic yards of soil.

Experiments with bin sterilizing showed that 6 lb. of steam would sterilize 1 cubic foot of soil efficiently, and the important point is brought out that, provided the assembly allows the full output of steam to be utilized, the time taken to sterilize the soil depends on the amount of steam per hour that the boiler can supply. Boiler pressure is secondary, and a pressure of 30 lb. per sq. in. is sufficient to operate the bins at maximum efficiency.

This is a most practical leaflet in the familiar John Innes tradition, and should be in the hands of anyone thinking of building or operating this type of sterilizing outfit.

R.T.P.

Farm Crops in Britain. SIR GEORGE STAPLEDON. Penguin Books. 3*s*. 6*d*.

The mixed pattern of British farming—crops, grass and stock, all on the same farm—has an overwhelming influence on the interest and beauty of the countryside. In this admirable addition to the Puffin Picture Books series, Sir George Stapledon describes the different crops which make up the rural scene, how they are grown, harvested and fed to stock, and the part they play in the economy of the farm and the nation. Here, by his ability to explain in simple and straightforward terms to his youthful readers plant growth, crop rotation, grass conservation, weed control and the numerous other activities which add up to farming, the author demonstrates yet again his mastery of his subject.

Mr. Badmin's illustrations, particularly those in colour, admirably and accurately portray the beauty of the countryside at different seasons of the year and add considerably to the attractiveness of the booklet.

Schoolteachers, parents and all whose calling it is to satisfy the inquiring minds of the young will find this little publication of considerable value, especially in urban areas where a better understanding of the importance of the countryside is a meritorious aim. In fact *Farm Crops in Britain* should prove an ideal companion to all who like the countryside and wish to know more about it.

A.D.B.

The Seasons Return. JOHN R. ALLAN. Hale. 15*s.*

This book is in the nature of a miscellany and does much to enhance Mr. Allan's well-earned reputation as a writer of distinction on the affairs of the farm. It is not a work on technical agriculture, of which we probably already have too many, but a volume written in Mr. Allan's attractive style for an odd half-hour or so of diversional reading.

It records in a whimsical way the author's observations and impressions of life on his Aberdeenshire farm and the people who work there: of a visit to Canada and an aged relative who lives in a log cabin on the edge of the Pacific: a trip to Brittany and a farm on the Downs: and a few chapters in the nature of a "mixed bag", including some excellent character drawing. Incidentally, I hope to hear more of those two worthies, Sandy, the 76 years old weather prophet and cynic, and Old Mossie, the happy husbandman. There is some very fine descriptive writing in the book, thus: "Sometime about the end of April the dairy herd go out to pasture by day. On the first day of freedom they are forces of nature let loose. They go daft with enlargement and delight. They look around and toss their heads at the joy of the sun and wind. They bore their horns into any soft piece of ground at the joy of touching earth. They lock horns and wrestle with delight of an encounter. They gallop across the fields in the most ludicrous way with their udders swaying from side to side. If the moon were out some of them would try to jump over it."

Altogether, this is a very good fifteen shillings' worth which should appeal to countrymen and townsmen alike.

G.F.P.

Annual Report of the National Institute of Agricultural Engineering and the Scottish Machinery Testing Station, 1954. 7*s.* 6*d.*

The testing of agricultural machinery is perhaps the first thing that springs to mind when the names of the National Institute of Agricultural Engineering and the Scottish Machinery Testing Station are mentioned. But, important as this service is, it should not be allowed to obscure the tremendous amount of other work connected with agricultural machinery being carried out at these two centres. The joint annual report of the two bodies does much to put matters in their right perspective. Progress is reported in all phases of growing, harvesting, drying and storing agricultural crops, and, on the horticultural side, in steam sterilizing, heating and irrigation. There is also a good deal about the development of special equipment for research or for specific or difficult tasks.

This is a stimulating review of some of the backroom work vital to the continued progress of mechanization in agriculture.

L.W.T.

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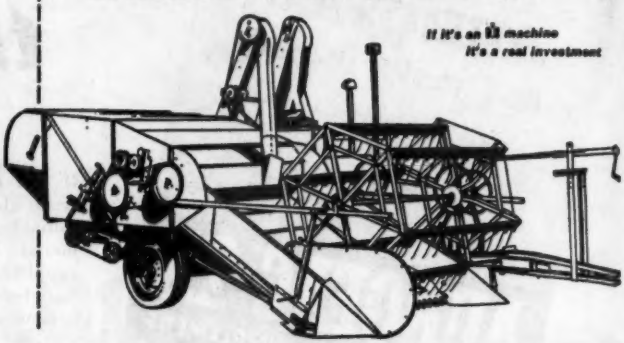

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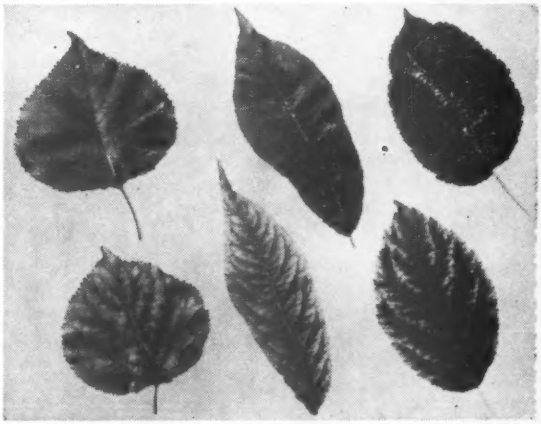

The V-shaped pattern of chlorosis due to manganese deficiency is shown above in the leaves of apricot, peach, and apple. The upper leaves are from healthy trees. Photograph reproduced by permission of Dr. C. G. Woodbridge and the Department of Agriculture, Ottawa.

Information and literature may be obtained from our Agricultural Department. If local merchants cannot supply manganese sulphate, please communicate with us.

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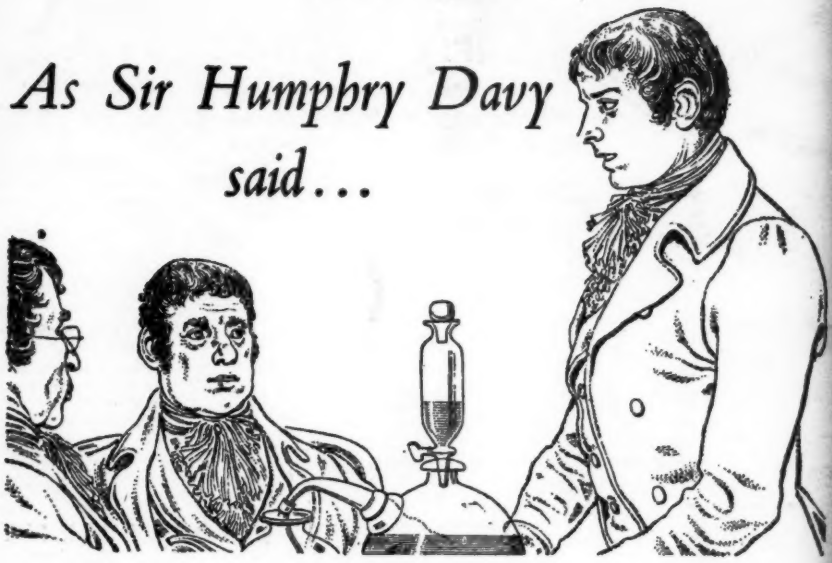
As Sir Humphry Davy said...



BEFORE 1802, few people associated chemistry with agriculture. In that year Sir Humphry Davy began a series of lectures for the Board of Agriculture, in one of which he said :

"The great purpose of chemical investigation in agriculture ought undoubtedly to be the discovery of improved methods of cultivation; and industry is never so efficacious as when assisted by science.

"Discoveries made in the cultivation of the earth, are not merely for the time and country in which they are developed, but they may be considered as extending to future ages, and as ultimately tending to benefit the whole human race; as affording subsistence for generations yet to come, as multiplying life, and not only multiplying life, but likewise providing for its enjoyment."

Great advances in agricultural research, to which Sir Humphry Davy gave such impetus, have since been made. Not the least of these is the increased knowledge of the value of nitrogen in the form of Sulphate of Ammonia and 'Nitro-Chalk'. The widespread use of nitrogen is largely responsible for the high yields obtained in present-day agriculture.

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